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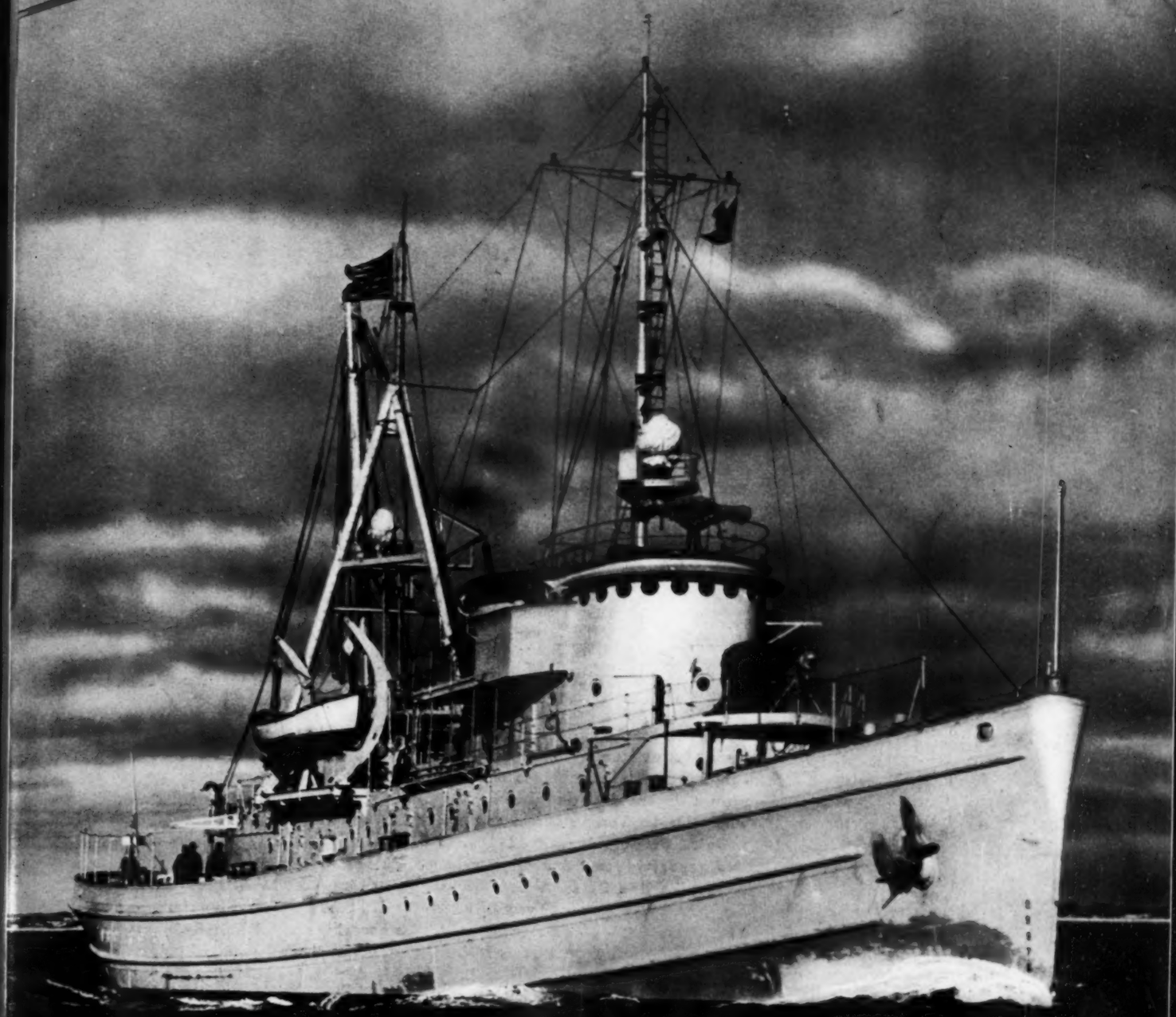

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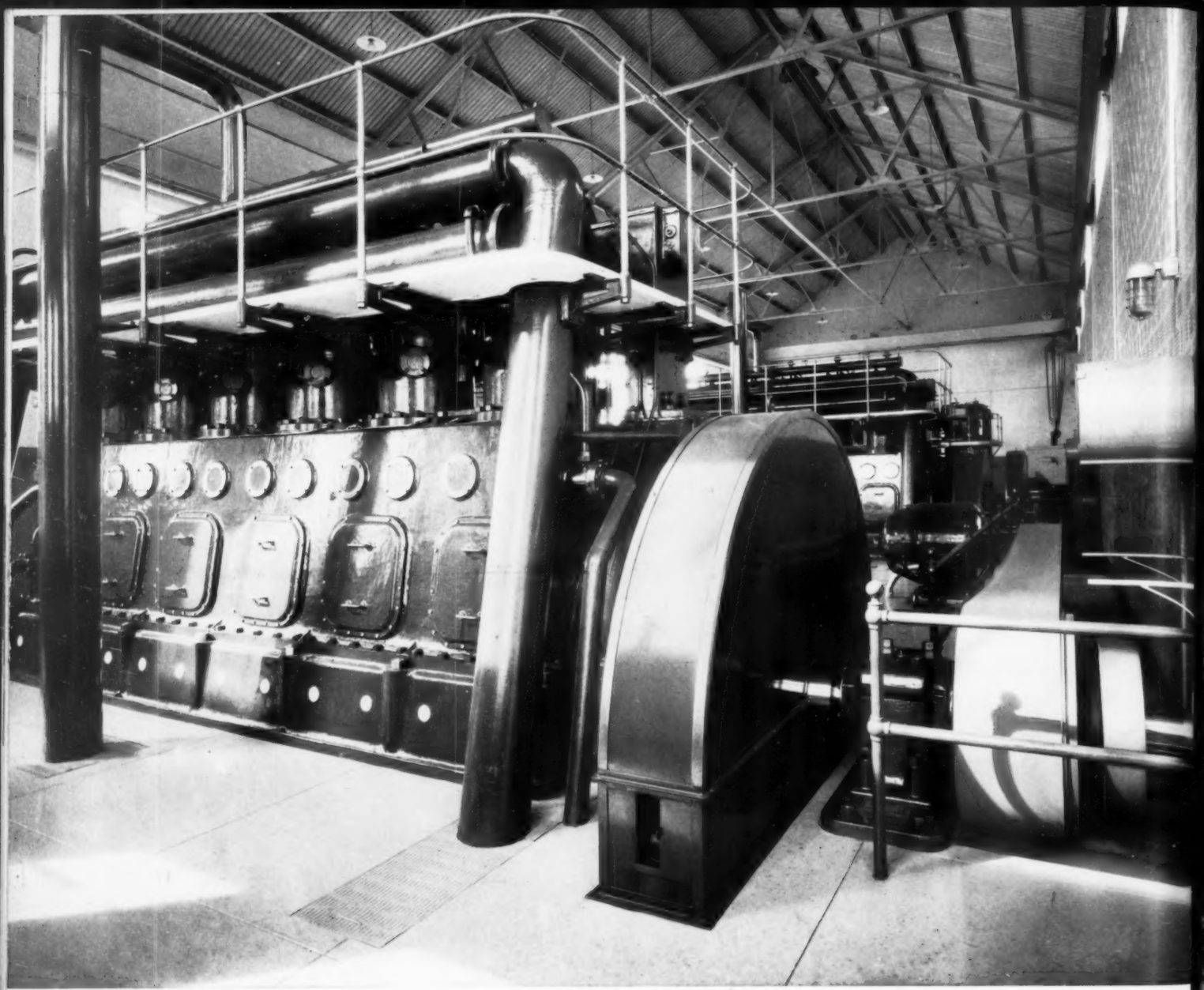

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DIESEL PROGRESS and DIESEL AVIATION

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REX W. WADMAN
Editor and Publisher

FRONT COVER ILLUSTRATION: The *U.S.S. Navajo*, one of the three new Navy Fleet tugs, a detailed description of which appears on pages 22, 23, 24, and 25 of this issue.

TABLE OF CONTENTS ILLUSTRATION: Typical use of Diesel engines in sawmill service. M. J. Ferrari, Placerville, California, is successfully using a Caterpillar Diesel to drive the sawmill illustrated above.

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HEYWORTH CAMPBELL
Art Director

PAUL H. WILKINSON
Aviation Editor

The eight cylinder, 21″x31″ NORDBERG Two Cycle Diesel rated at 3180 hp. installed in the power plant of the Bermuda Electric Light, Power & Traction Co., Ltd., Pembroke, Bermuda.

ERIE

This eight cylinder, 3180 hp. Diesel, built by Nordberg Manufacturing Company and installed in the Bermuda Public Utility Plant at Pembroke, Bermuda, is equipped with an Erie crankshaft.

The Erie Forge Company makes rough and finished connecting rods, piston rods, crossheads, generator and extension shafts and crankshafts for all makes and types of Diesel engines

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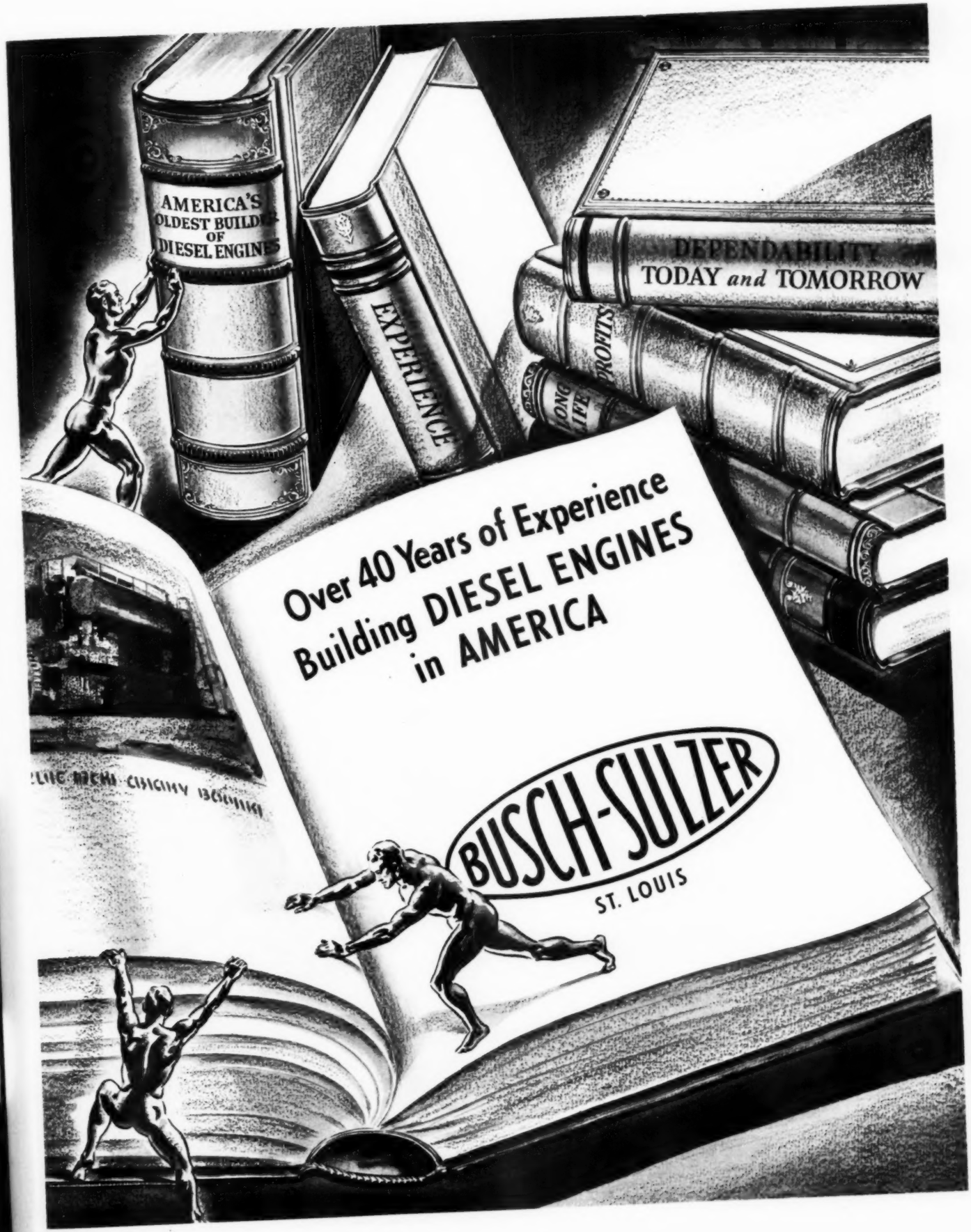
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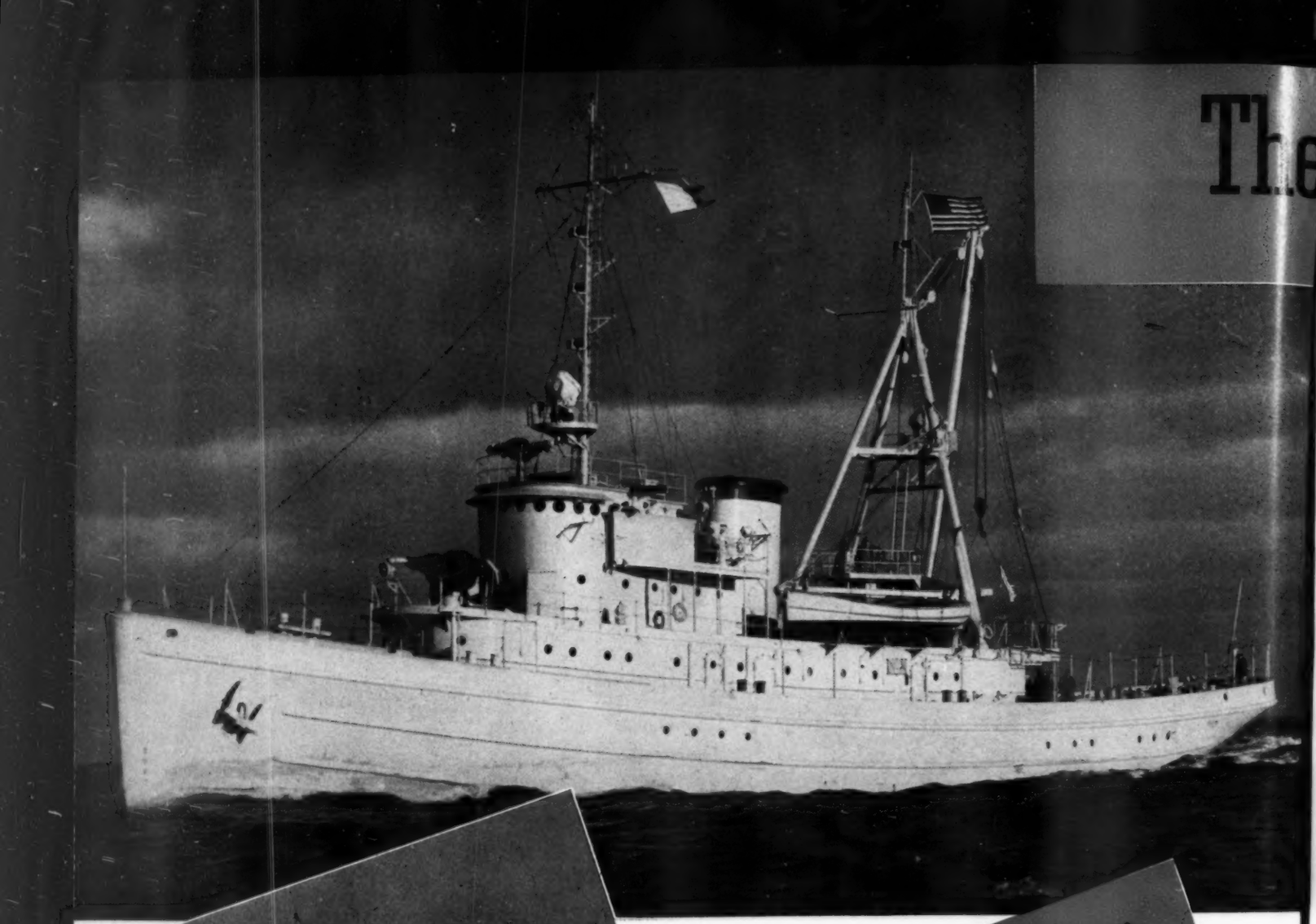
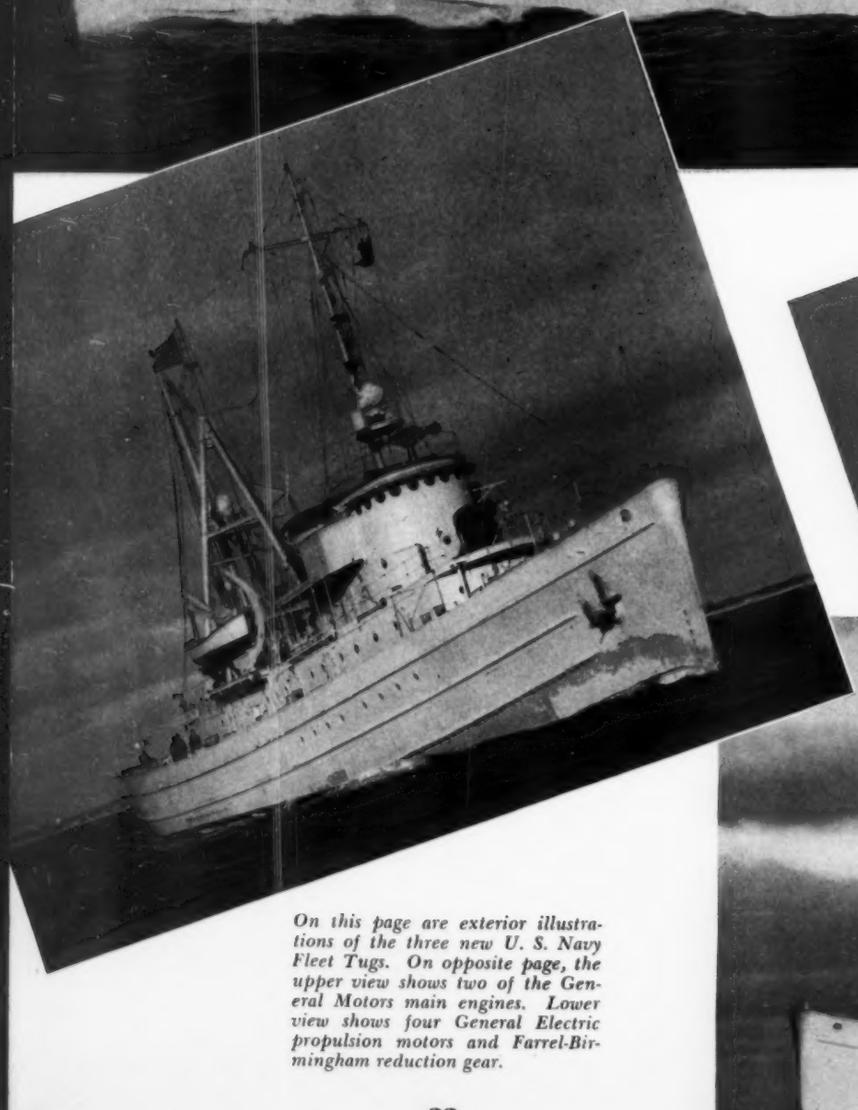




The United States Navy Commissions Three Diesel-Electric Fleet Tugs

U.S.S. NAVAJO
U.S.S. SEMINOLE
U.S.S. CHEROKEE

On this page are exterior illustrations of the three new U. S. Navy Fleet Tugs. On opposite page, the upper view shows two of the General Motors main engines. Lower view shows four General Electric propulsion motors and Farrel-Birmingham reduction gear.

The Three New Navy Fleet Tugs

By REX W. WADMAN

All illustrations from official United States Navy photographs

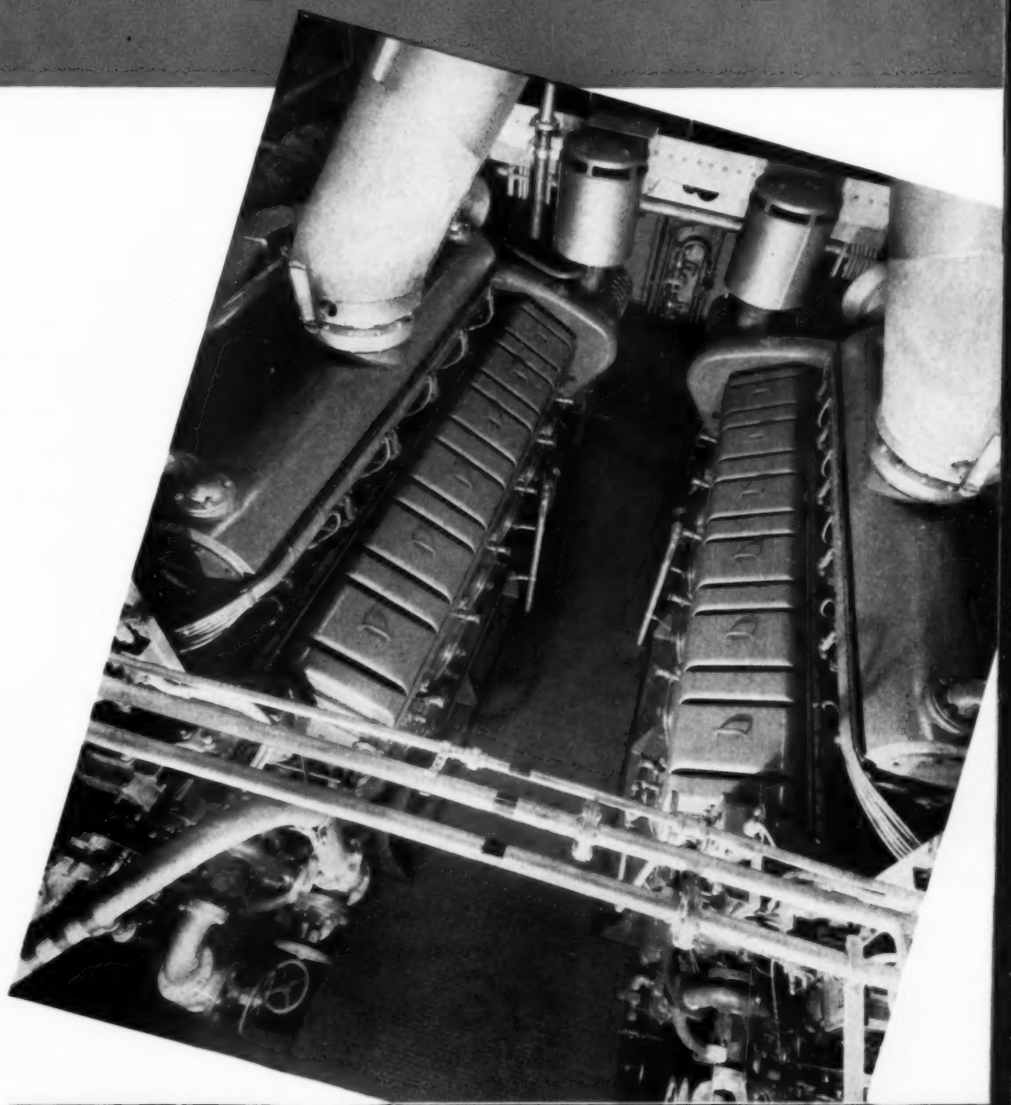
OUR progressive Navy tore a chunk out of the book of precedents and threw it overboard when it designed the three new Fleet Tugs recently completed at the Staten Island yard of the Bethlehem Steel Company. Selection of Diesel-Electric drive for these three big tugs typifies the splendid spirit of progressiveness which permeates our whole Navy in the building up of our first line of defense to be second to none in the world.

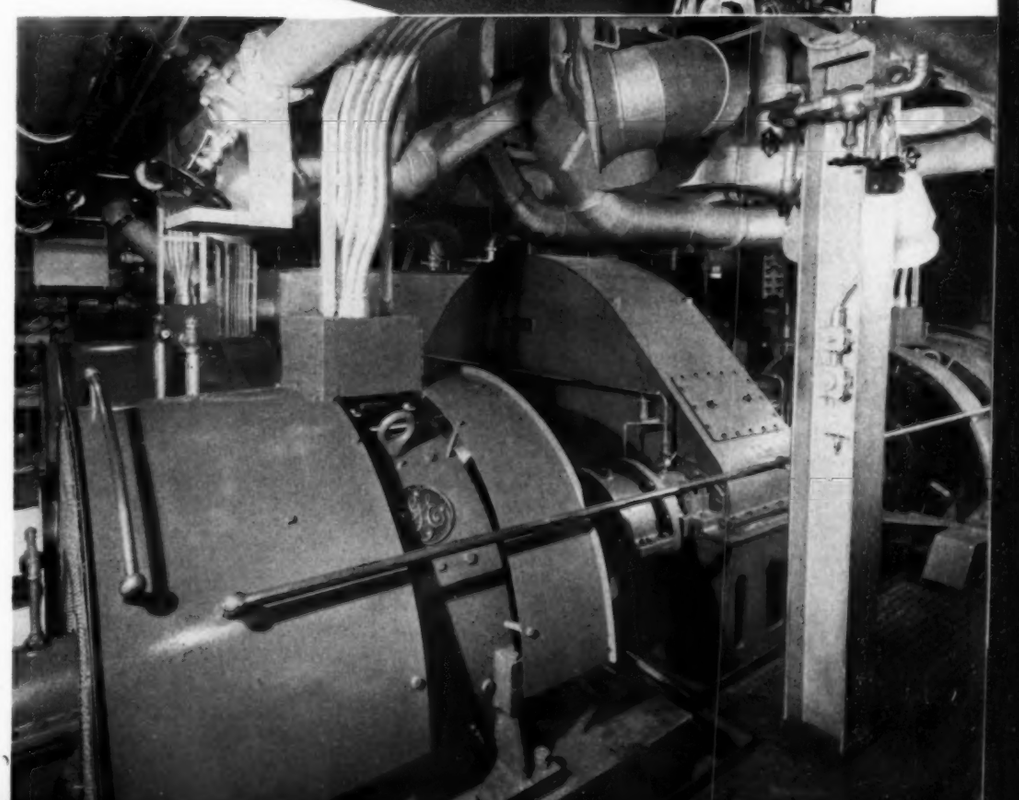
The *Navajo* – the *Seminole* – the *Cherokee* – three fine old American Indian names which have been given to these three Navy Fleet Tugs. Each tug is 205 ft. x 38 ft. 6 in. x 14 ft 3 in. Large fuel and lubricating oil capacity provide ample cruising radius. Speed on trials was better than 15 knots.

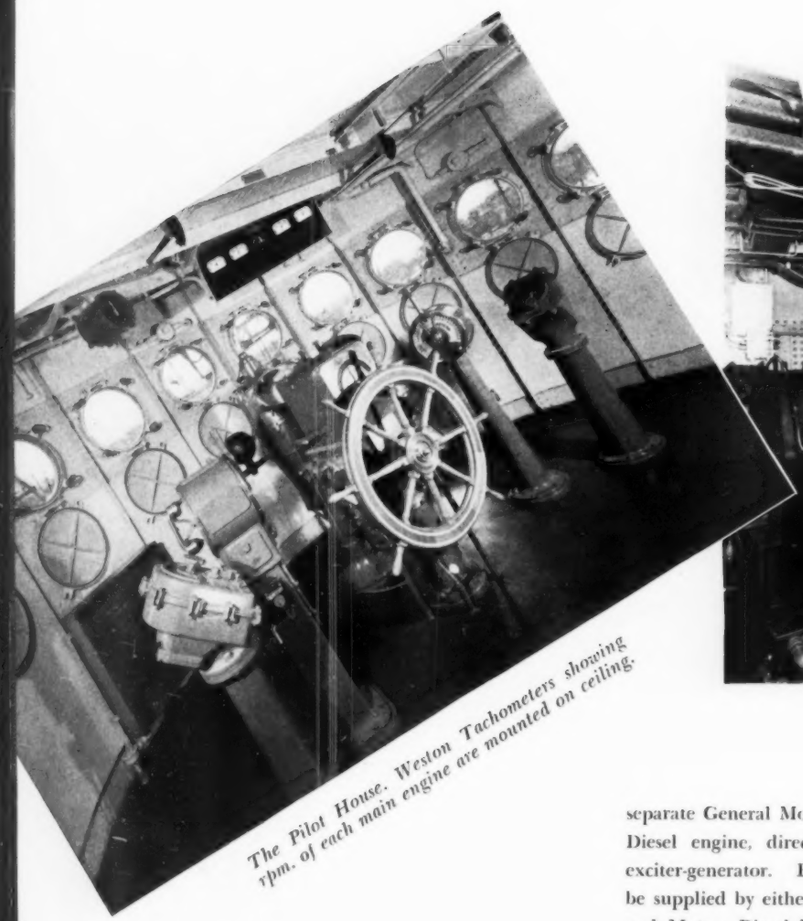
Because these three vessels are essentially first line ships, that is all which can be said at this time about the tugs themselves, but we are permitted to discuss at some length the extremely interesting propulsion equipment, which consists of four model 12-567 General Motors, twelve cylinder, V-type, two cycle Diesel engines rated at 950 hp. each at 750 rpm., a total of 3,800 hp. of main engines. The auxiliary engine installation consists of two model 233-A General Motors eight cylinder, four cycle Diesel engines, each rated at 150 hp. at 1,200 rpm., and one model 6-71 General Motors six cylinder, two cycle Diesel engine rated at 90 hp. at 1,200 rpm.: A total of 390 hp. in auxiliary power, giving a total of 4,190 hp. aboard each tug for all purposes.

So, the Navy has pioneered in the adaptation of a multiple Diesel engine installation in these powerful, highly important new additions to the Fleet and the Navy definitely broke with precedent in laying out the engine room for these tugs, not only in selecting Diesels for the main drive, but also in selecting Diesel-Electric drive through a reduction gear to one propeller.

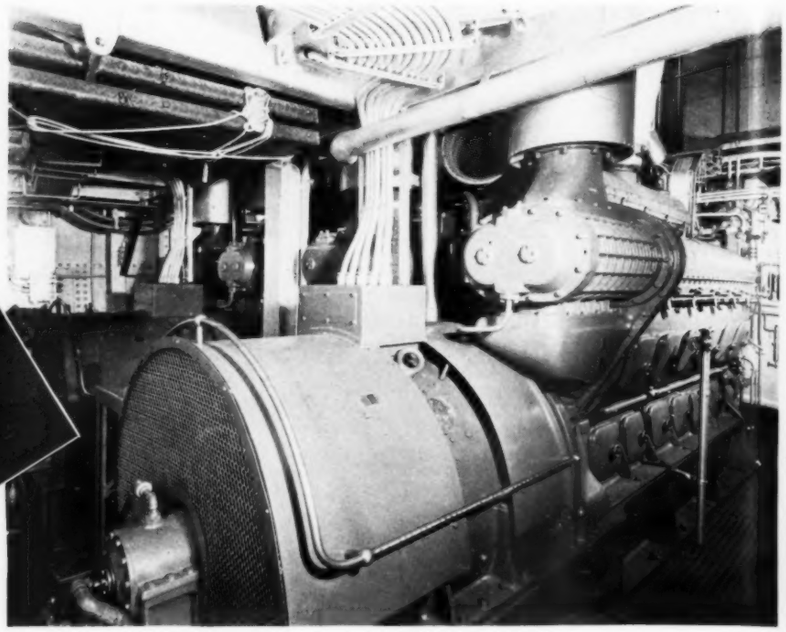
In taking this progressive step the Navy has built three ultra-modern Fleet Tugs in which has been incorporated extreme flexibility of operation, extremely low operating costs, plus







The Pilot House. Weston Tachometers showing rpm. of each main engine are mounted on ceiling.



Generator end of one of the four General Motors main engines, each rated at 950 hp.

the minimum amount of space devoted to machinery.

The four main engines with their generators are separated completely from the propulsion motor room by a through bulkhead, a unique feature of design only practical with a Diesel-Electric layout.

The propulsion and auxiliary power equipment installed aboard each of the three Diesel-electric tugs includes the following items:

Four main propulsion motors, each 550 volts, single armature type, separately excited from a 120-volt supply.

Four main generators, each 550 volts, separately excited from a 120-volt supply, Diesel-engine driven.

One exciter, rated 60 kw., 1200 rpm., 120 volts, self-excited, Diesel-engine driven.

Two ship's service generators, each rated 100 kw., 1200 rpm., 120 volts, self-excited, Diesel-engine driven.

Current for excitation of the four main generators and four main motors is supplied by a separate General Motors, Model 6-71 two cycle Diesel engine, direct-connected to a 60 kw. exciter-generator. Emergency excitation may be supplied by either of the two 100 kw. General Motors Diesel-driven ship's service generator sets. The 60 kw. engine-driven exciter supplies power to the excitation bus for the fields of the main motors and generators. The 100 kw. ship's service generators can also supply power to the excitation bus, but the switches are arranged so that only one of these machines can be connected to the excitation bus at one time. The 100 kw. generators also supply the general ship's service power and lighting circuits. Either GEN 1 or GEN 2 may be connected to the auxiliary-power bus by throwing the main switch to the AUX. P. position. The main switches of these two main generators are interlocked so that only one can be thrown to the AUX. P. position at once.

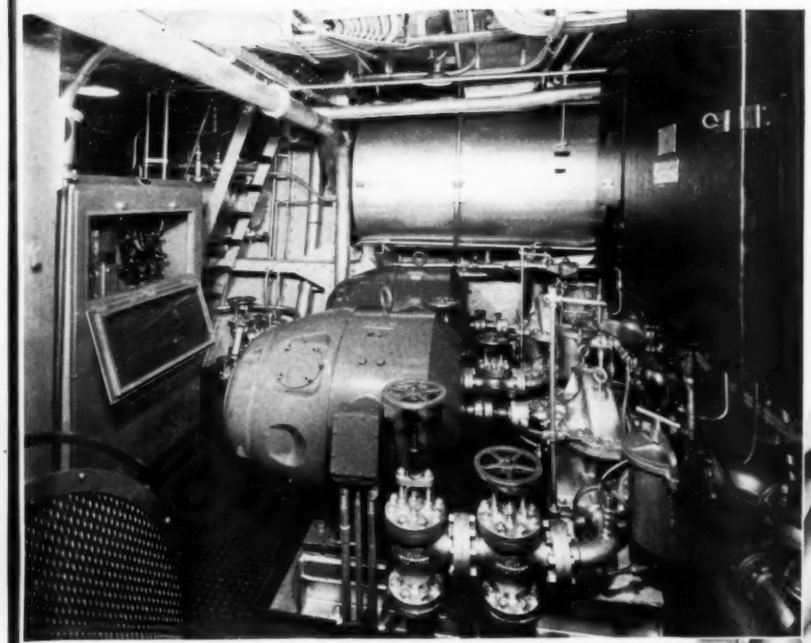
The arrangement of the equipment is shown in Fig. 1. Power for the propulsion motors is furnished by the main generators. The motors drive the propeller through reduction gears manufactured by the Farrel-Birmingham Company. The propulsion gear unit is of the two bearing, single reduction type, fitted throughout with Timken roller bearings and provided with a self-contained lubricating system.

The speed of the vessel can be controlled from the pilot house or from the engine room by varying the strength of the generator field and/or the speed of the driving engines. It is also possible to use either one or two of the main generating units to supply power for extra heavy auxiliary loads, such as the electrically-operated towing engine.

The main propulsion control consists of four generator panels and one motor panel. Each one of the main generator panels contains a voltmeter, generator field ammeter, and engine speed indicator, together with a hand wheel which connects the corresponding generator for starting or propulsion. In addition, the hand wheels on two of these panels control the set-up for providing the power for the extra heavy auxiliary loads. The motor panel contains the following instruments: motor ammeter, motor field ammeter, excitation voltmeter, motor and ground detector, voltmeter, master shaft revolution indicator, engine order telegraph indicator. It also contains the main control operating hand wheel, transfer control hand wheel, and motor field rheostat hand wheel.

After all engines are connected to the propulsion bus, the boat is operated from full speed ahead to full speed astern by operating the one control operating hand wheel on the motor panel, or, if desired, the transfer switch may be set for operating from the pedestal control in the pilot house.

It can be seen that complete flexibility is obtained in that the operator has control of both

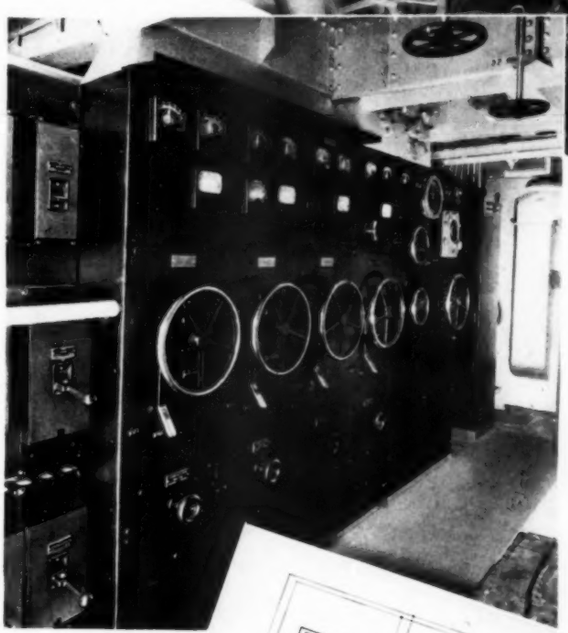


A pump bay with 100 kw. auxiliary Diesel generating set, encased in Hussman Accoustic Hood and mounted on Hussman Spring Base, at left

the number of engines used for propulsion and the engine speed. This flexibility permits the ship to be operated even above half speed by the use of but one main engine at very little over the idling speed of the engine.

General Electric Company supplied all the main generators, propulsion motors and electric auxiliary power equipment, and Woodward governors are on all main and auxiliary Diesels. Harrison heat exchangers are used throughout all three tugs for the closed cooling water system and for the lube oil lines. There is a Goulds Hydroil on the lube line and the fuel line in each tug. Purolator filters are installed on lube lines of all main engines. An interesting feature of the three auxiliary engines is that they all are mounted on Hussman Spring Mountings to eliminate vibration and each auxiliary engine is encased in a Hussman Accoustic Hood to segregate engine noise from the rest of the ship when nothing but auxiliary engines are in operation or needed, thus greatly contributing to the comfort of the officers and crew. Engineering Specialties supplied the Vortex spark arresting silencers and there is a Weston tachometer for each main engine on the switchboard and mounted in the pilot house.

Again, congratulations to our United States Navy for progressive thinking and acting in building these three fine Diesel Electric Fleet Tugs.



Top: Battery of Purolator lube oil filters in foreground Harrison heat exchangers above and Goulds Hydroil on lube line below. At left is the control panel section of the main switchboard and below is Figure No. 1 showing general arrangement of the machinery.

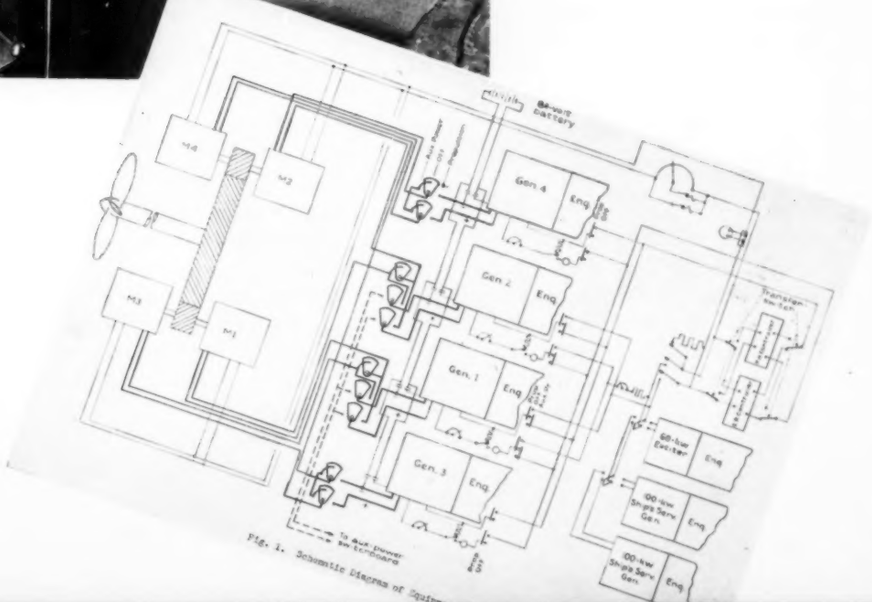


Fig. 1. Schematic Diagram of Machinery

This huge emporium is lighted inside and outside by two Caterpillar Diesels and Star generators. Waste heat from engine jacket water heats the enclosed dining porches and domestic hot water.

ROADSIDE REST, OCEANSIDE, L. I.

By DWIGHT ROBISON

FOR twenty years Leon Shor and Murray Hatfield have been serving the public with good food and warm hospitality at Roadside Rest, Oceanside, Long Island. From a one-man hot dog and hamburger stand, this now famous emporium has grown to cover five acres with facilities for both indoor and outdoor dining and dancing, as well as parking space for a thousand cars. Similar Roadside Rests, established by and from the experience of Messrs. Shor and Hatfield, are flourishing at Miami, Florida, and on Sunrise Highway, Long Island. At Oceanside it is common practice for the public to consume a ton each of hot dogs and hamburgers most any sunny Sunday. That is roughly 16,000 hot dogs to those of us who just eat them.

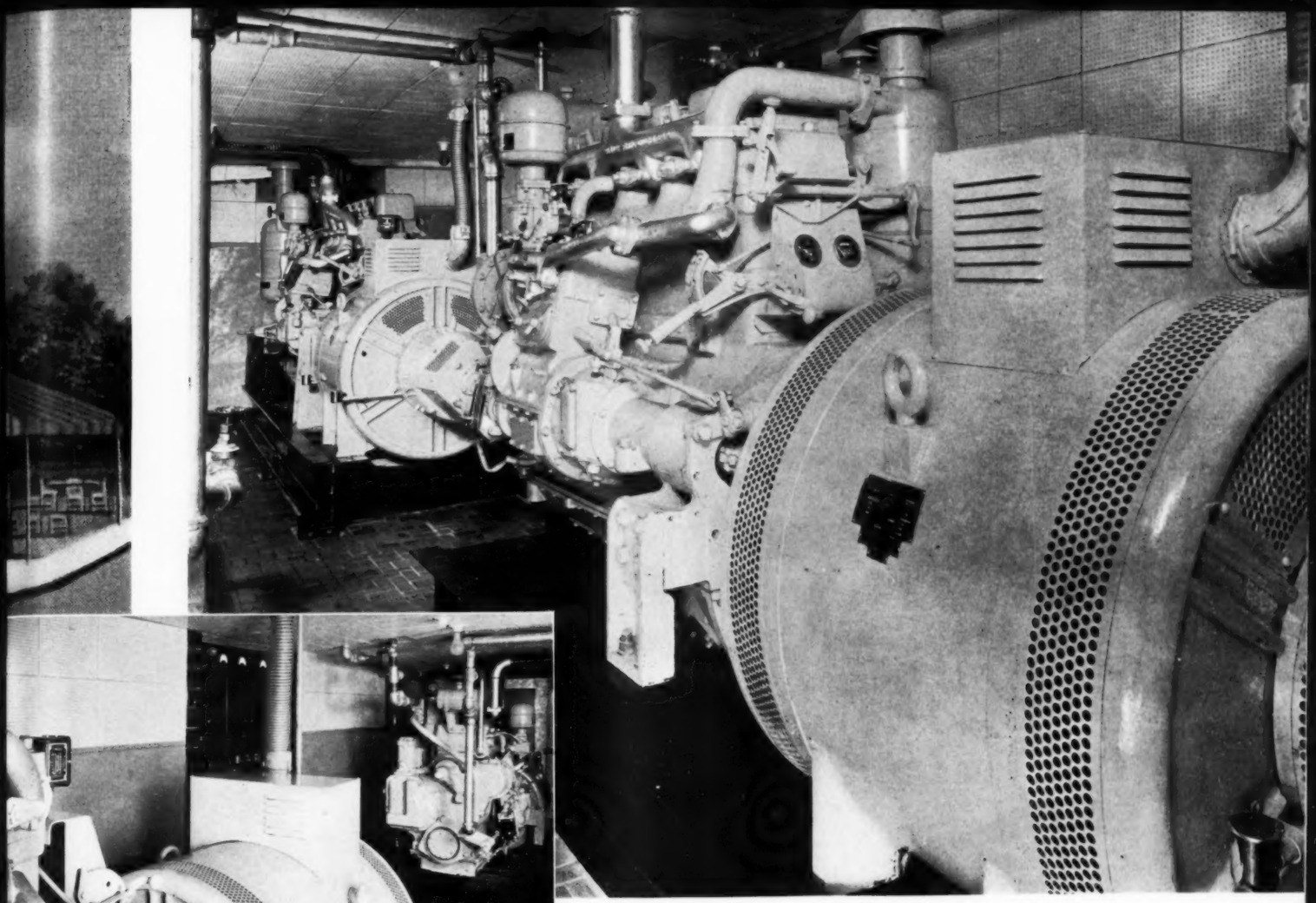
Mr. N. R. Schafler of Atlantic Heat & Power, Inc., after patronizing Roadside Rest for some time, suddenly realized that the cost of lighting this extensive establishment inside and outside, in addition to heating its large dining rooms and porches, must be terrific. He was right in his assumption and he had little difficulty in developing an acceptable proposition predicated on lighting with Diesel generated current and space heating with waste heat from the engine jacket water.

Two Caterpillar Diesels have just taken over the job and the present rate of saving over utility cost for current only is $3,072 per year. A further saving estimated at $60 per month will be realized through heat recovery for space heating and domestic hot water.

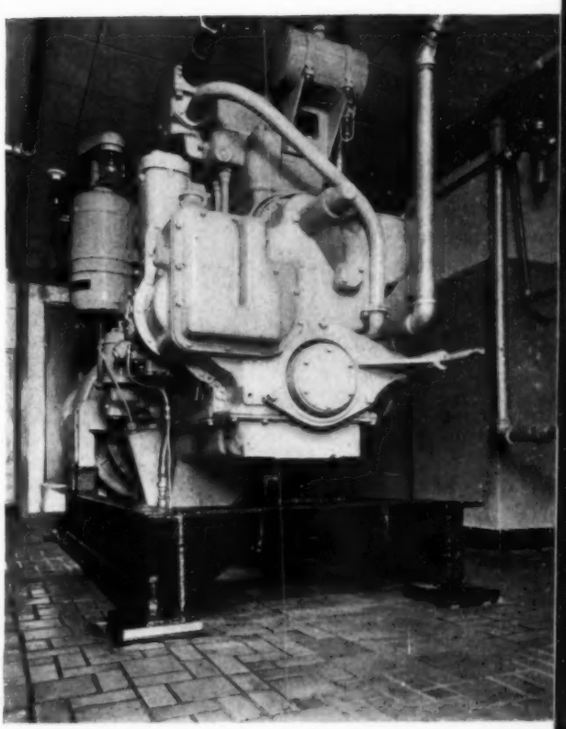
One 6-cylinder, 4-cycle, 5¾ in. bore, 8 in. stroke, 900 rpm., 95 hp. Diesel is direct-connected to a Star 70 kw., 220/110 v., single phase alternator. The other unit is a 4-cylinder, 4-cycle, 5¾ in. bore, 8 in. stroke, 900 rpm., 60 hp. Diesel, direct-connected to a Star 40 kw. alternator. Both generators are equipped with built-in voltage regulation. The Diesels are self-contained units with built-in fuel pumps, 2-cylinder gasoline starting engines, Purolator lube oil filters, Donaldson intake air filters for both the main and starting engines, and Pickering governors. Piston rings are Perfect Circle. The engines are operating on Paragon fuel and lube oils.

The quiet atmosphere of Roadside Rest could not be jeopardized for the sake of cutting the light bill by better than 75 per cent. Both vibration and sound must be withheld from not only the dining rooms and porches, but also from the open air dining and dance area adjacent to the engine room. Korfund Vibro-Damper bases under each engine-generator unit effectively handle the vibration. Burgess exhaust snubbers render the exhaust inaudible and Celotex acoustic tile on engine room walls and ceiling completes the job of isolation.

Simplicity marks every feature of this installation. Except for starting, stopping, or switching of engines by one of the regular staff, the plant runs continuously, without attention, from 7 A.M. to 2 A.M. in the winter and will run twenty-four hours a day in summer. Minneapolis-Honeywell aquastats on the jacket water sys-



These views emphasize the compactness and neatness of this installation. Note Donaldson intake filters on both main Diesels and gasoline starting engines. Note the fabricated steel sub-base which rests on Korfund Vibro Dampers flush with the floor.

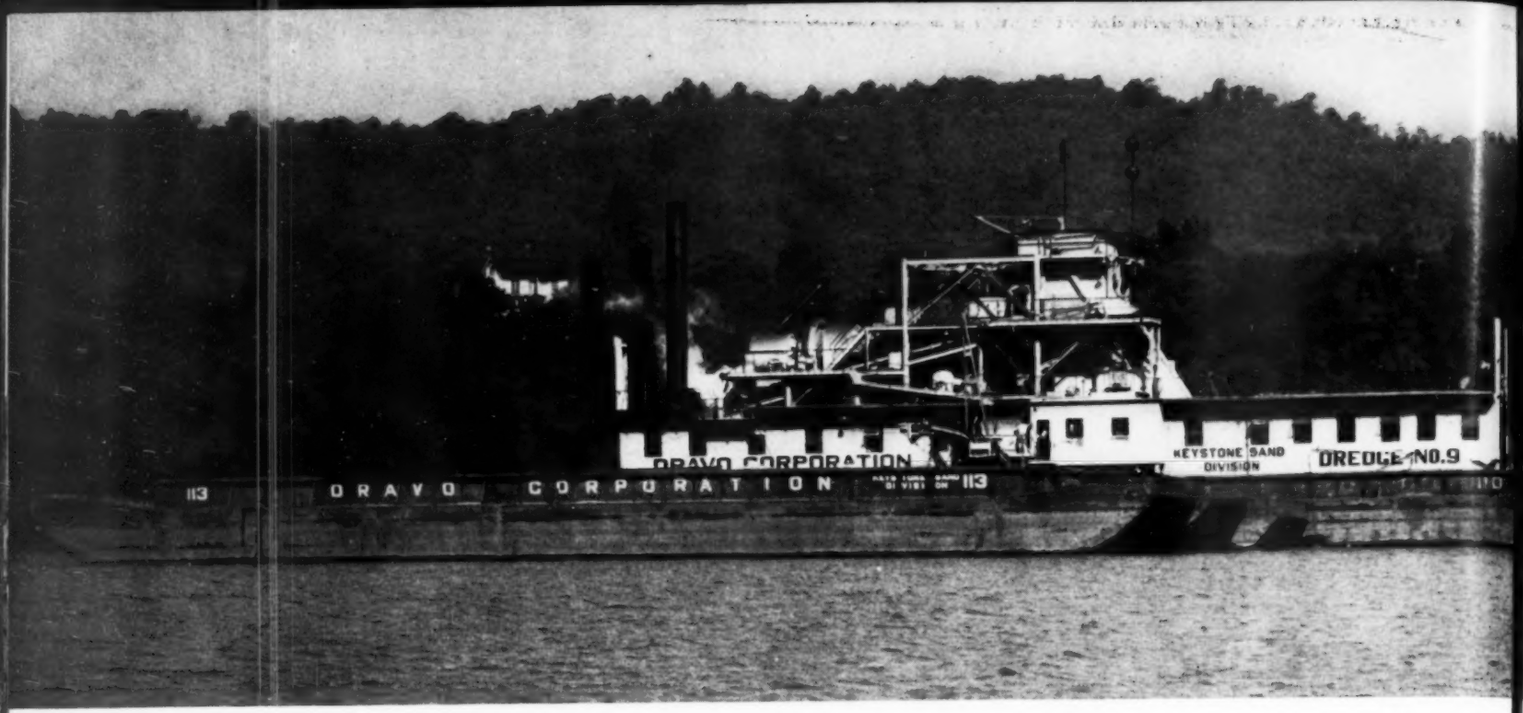


tems and Pressurtrols, of the same make, on the lube oil systems are connected to bell and light alarms in the kitchen to give warning of abnormal conditions. For winter operation, the engine jacket water at 180° is pumped by a Westco 50 gpm. positive displacement pump through four Ilg unit heaters which blow warm air through the spacious, glassed-in porch. From the heaters, the water is returned at 110° to an open surge tank on the floor above the engines, from whence it returns by gravity to the engines. Should the return water from the heaters exceed a temperature of 145°, an aquastat actuates a solonoid valve which admits cold water to the surge tank from the city mains. A float valve limits high and low water levels in the surge tank on the floor above the engines.

During the summer months, the engine jacket water heat will be extracted by a Ross exchanger to heat the domestic water supply. A cooling tower will be added to release excess jacket water heat.

The compact two-panel switchboard is mounted in a recess in the engine room wall and is set off by black tile. Each panel carries Weston voltmeter, ammeter, and field rheostat, and a generator switch. A Sangamo Watthour meter completes the switchboard apparatus.

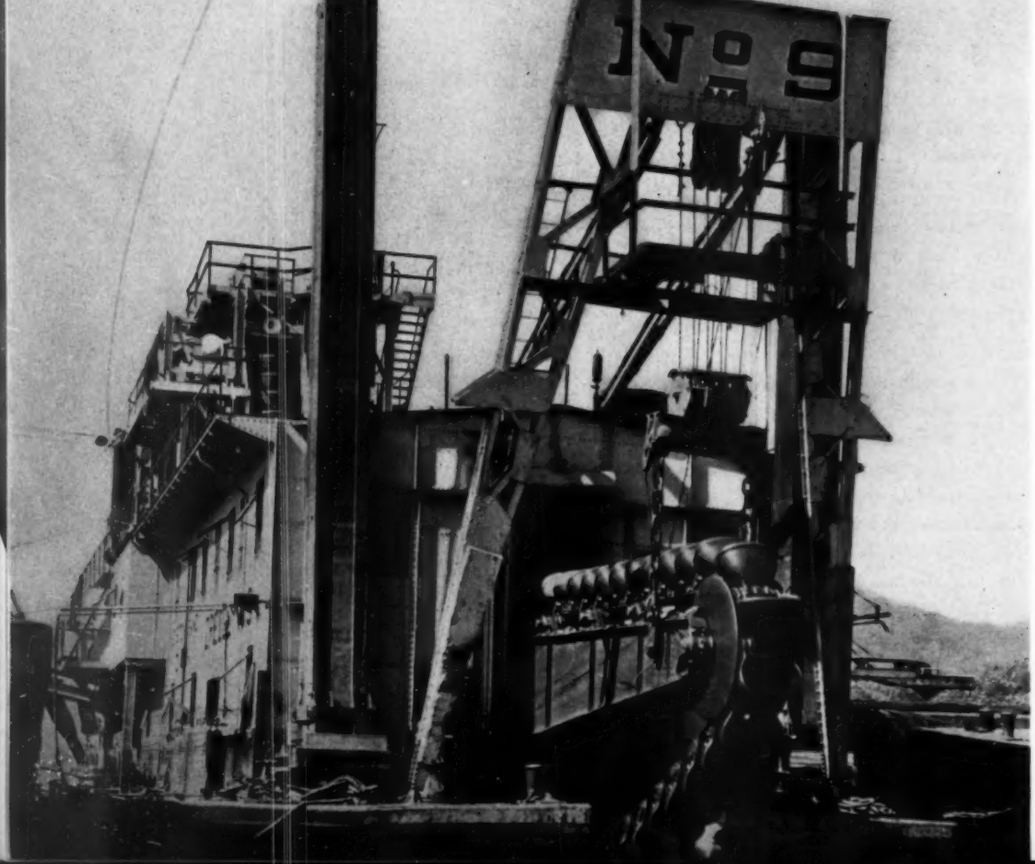
The general public attracted to the Roadside Rest is much intrigued upon learning that Diesel engines are responsible for the outstanding interior and exterior lighting effects, as well as the warmth of the glassed-in porch on cold winter days. They frequently ask to see the plant and they go away singing praises of Diesel engines. Mr. Schafler, Chief Engineer of Atlantic Heat & Power, Inc., designed and installed the entire Diesel plant and heating system.



"On location" . . . Dravo Corporation's Diesel-powered dredge No. 9 surrounded by the barges which will take its various products to market.

DRAVO DREDGE No. 9

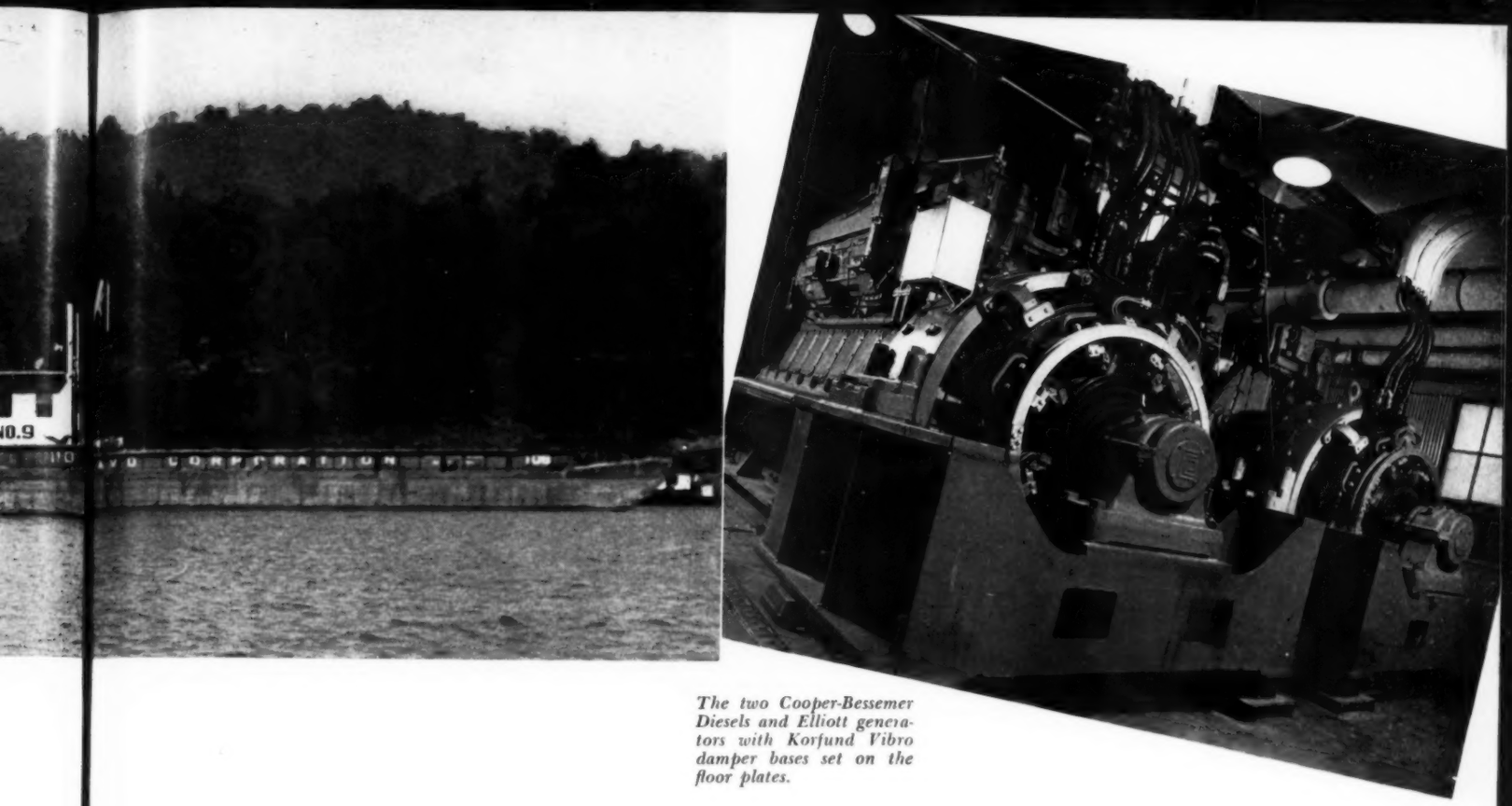
By GEORGE D. CROSSLEY



IN order to produce the "quality specification" sand and gravel demanded by concrete technicians today, the Keystone Sand Division of Dravo Corporation, Pittsburgh, Pa., recently revamped its dredge No. 9, enlarging it, and putting in $250,000 worth of new equipment.

Tests have shown that stronger concrete can be made with less cement, providing the sand and gravel meet rigid specifications of cleanness, uniform grading, proper particle shapes, and a greater percentage of fines in the sand. To make such material, it was decided to expensively alter the company's dredge No. 9, this work being done at the marine ways and outfitting dock of Dravo's Engineering Works Division at Neville Island, on the Ohio River just below Pittsburgh.

Because so much new machinery was needed, the hull of the dredge had to be made larger to develop greater displacement and more deck space. Originally measuring 145′ x 38′ x 6′ 9″, the hull was split in two and a prefabricated



The two Cooper-Bessemer Diesels and Elliott generators with Korfund Vibro damper bases set on the floor plates.

section 12 ft. 6 in. long was inserted. The hull also was opened lengthwise on each side and a section 6 ft. 6 in. wide was inserted on the starboard side and a 5 ft. 6 in. section added on the port side. These sections increased the buoyancy and provided two additional watertight compartments. The remodeled hull, 12 ft. wider and 12 ft. 6 in. longer, was also equipped with additional trusses to carry the increased weight of the superstructure which was extensively altered to accommodate the installation of new power and processing machinery.

No change was required in the digging mechanism, but new processing equipment installed included a new vibrating scalping screen, five new vibrating screens for grading and separating, two rotating material scrubbers, an adjustable impact crusher, four new belt conveyors, chutes and hoppers for classifying and remixing materials, and two 3-drum warping engines. The equipment is all motor-driven, 13 large motors being required all told. Thus, increased generating capacity was required.

The new power plant consists of two Cooper-Bessemer 8-cylinder Diesel engines, rated 210 to 300 hp., direct-connected to Elliott 250-volt, variable-speed, direct-current generators. The kilowatt output of each generator increases from 140 kw. to 200 kw. as the speed is increased from 525 to 750 rpm. At the present time the units are operating at 550 rpm. To get more power for increased capacity of the dredge, it is only necessary to speed up the Diesel engines. The engine governors are Woodward type "SI." The generators are unusual in that they operate under this variable speed range and maintain constant voltage. This is accomplished without a voltage regulator and without separate exciters. Voltage regulation obtained is very satisfactory over the entire range of speed. Automatic overvoltage relays are installed to prevent a voltage increase over a predetermined limit when the Diesel engine speed is increased, should the operator fail to adjust the setting of the field rheostat.

Another outstanding feature of the installation of these two Cooper-Bessemer Diesel engines is that each engine is mounted on ten Korfund steel spring Vibro dampers as is evident from the engine illustration herewith. The use of Korfund dampers makes it possible to set these two big engines on the floor plates of the dredge without transmission of normal operating frequencies to the steel hull.

As soon as the second engine was installed, dredge No. 9 started work in the Ohio River, near the Dravo shipyards on Neville Island, and results quickly established her excellent efficiency. The dredge is a complete sand and gravel factory which converts the raw material found on the river bottom into thoroughly clean and properly graded gravel and finely screened sand. The first stage ladder of buckets carries the raw material from the river bed to the "scalper," a coarse screen which merely rejects large rocks and objectionable material. Cobblestones too big for use in their natural state are sent by belt conveyor to crushers. From the scalper, a second ladder carries the material to the top of the superstructure, where it begins to encounter the various washers, scrubbers, and classifying screens that insure cleanliness and uniform grading. The photographs reproduced show some of the processes. Clean, well-graded sand is delivered to the barges because efficient screens, improved dewatering, and crusher-made fines assure the production of a superior product. The addition of two rotating material scrubbers greatly improved the general operations of this dredge. Ultimate quality of material depends largely upon violent vibration which keeps the particles separated and permits more thorough washing and screening.

The dredge works with two barges on each side, running different classifications of material into each barge. The barges, which hold from 500 to 690 tons of material each, are towed away when filled and replaced with empties. The dredge turns out material at the rate of 400 to 500 tons per hour. It has furnished much sand and gravel for concrete work on the famous Pennsylvania Turnpike, between Pittsburgh and Harrisburg, now being rushed to early completion, and its Diesel-generating units continue to furnish dependable, flexible power, with ample reserve capacity.

The new administrative building includes offices, hospital facilities, and staff dining rooms.

Ground plan showing distribution of the various units which make up the Brunswick Home

BRUNSWICK GENERAL HOME

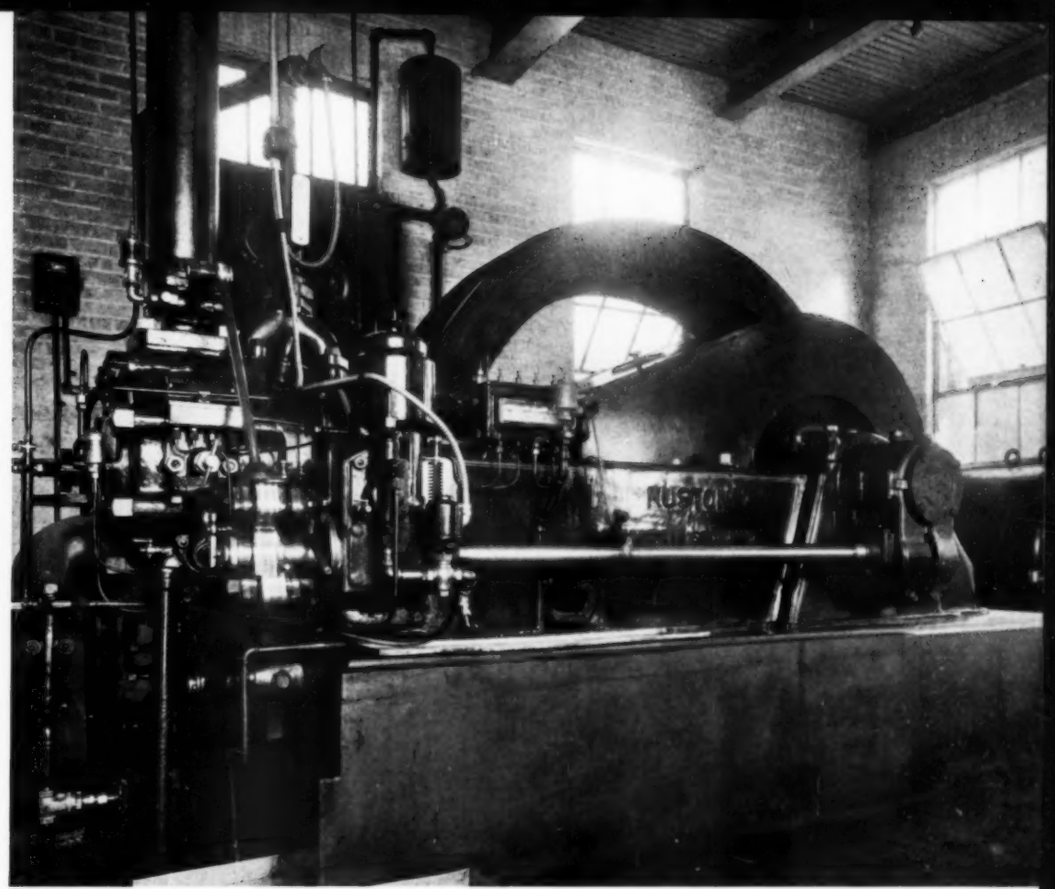
By DWIGHT ROBISON

THE Brunswick General Home at Amityville, Long Island, dedicated to the care of a large variety of special sanitarium cases, is typical of the many institutions now enjoying immunity from light and power current failures through self-owned and operated Diesel electric generating plants. Unfailing electric current is of prime importance in the care of the sick. Next in importance to private institutions of this sort are the economies in the cost of electric current which the individual Diesel plant invariably effects.

Spread over two city blocks are the fifteen buildings and cottages which comprise the Brunswick General Home. General equipment includes complete hospital facilities such as modern x-ray laboratory and operating rooms. Excepting three cottages, located apart from the general grounds, which are still on utility light service, the entire electric load of this sanitarium is undertaken by the Diesel generating plant. Mr. C. F. Vetter, Jr., of Peet and Powers, Inc., New York, designed and installed the plant, using a Ruston slow speed, heavy duty horizontal Diesel engine of the single cylinder type, having a 12½" bore and 22" stroke, 66-73 hp. The engine is V-belted to a Star 44 kw. alternator with built-in voltage regulator. Compressed air for engine starting is secured by exhausting the engine compression back into a storage bottle after the engine has attained a speed sufficient for the kinetic energy of the flywheel to carry over for eight or ten revolutions. This arrangement eliminates the usual auxiliary air compressor.

The Ruston engine accessories consist of a Teesdale automatic fuel transfer pump with a Goulds emergency hand pump, an American intake air filter and a Burgess Snubber in the intake line. Cooling is effected by a window mounted Rome Turney radiator fitted with a De Bothezat fan which is actuated by a Mercoid automatic thermostatic switch in the jacket water system.

Standing by to take overloads and emergency demand is a Superior six-cylinder, 4½" bore, 5¾" stroke, 75 hp. Diesel engine, direct connected to a Star 50 kw. generator. This engine is equipped with American Bosch injection, Purolator fuel oil filter, Pierce governor and Leece-Neville electric starting motor. Cooling is handled by the system described above. The



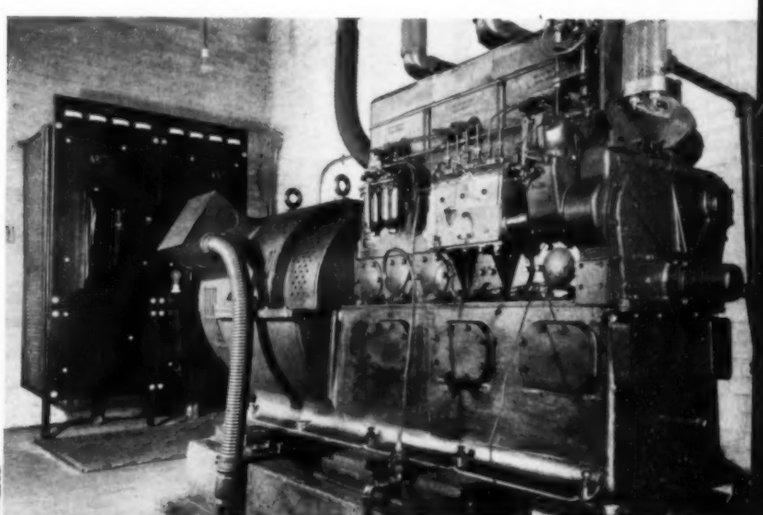
The Ruston heavy duty horizontal Diesel and Star main generating unit.

Superior Diesel is mounted on a vibration absorbing base supplied by the Vibration Eliminator Company. Lube oil is Gulf Parvis M. A Briggs batch reclaimer handles the lube oil from both engines.

The Seaboard Electric switchboard is equipped for manual paralleling of the engines and carries a specially designed automatic switch which starts the standby engine when the voltage on the main generator drops to 90 V.

The installation is simple in setup and operation and requires no extra help for maintenance. It has a perfect performance record of two years. The expense charged to the plant for the year 1939 totalled $1447 which included cost of fuel and lube oil, inspection and repairs, and insurance. Utility charges for the five years prior to installation of the Diesel plant averaged $5500. per year. The Diesel generating plant has therefore reduced current cost by *74 per cent.*

In speaking of the saving in favor of the Diesel Plant, Dr. C. L. Markham, treasurer and physician-in-charge, pointed out that they have installed several outside floodlights and have generally added to the electrical load since the Diesels were installed. The matter of electrifying the kitchens is now under consideration.



The Superior Diesel and Star generator standby unit.

General view showing main and standby engines. Note Briggs lube oil reclaimer, lower center.

8 more

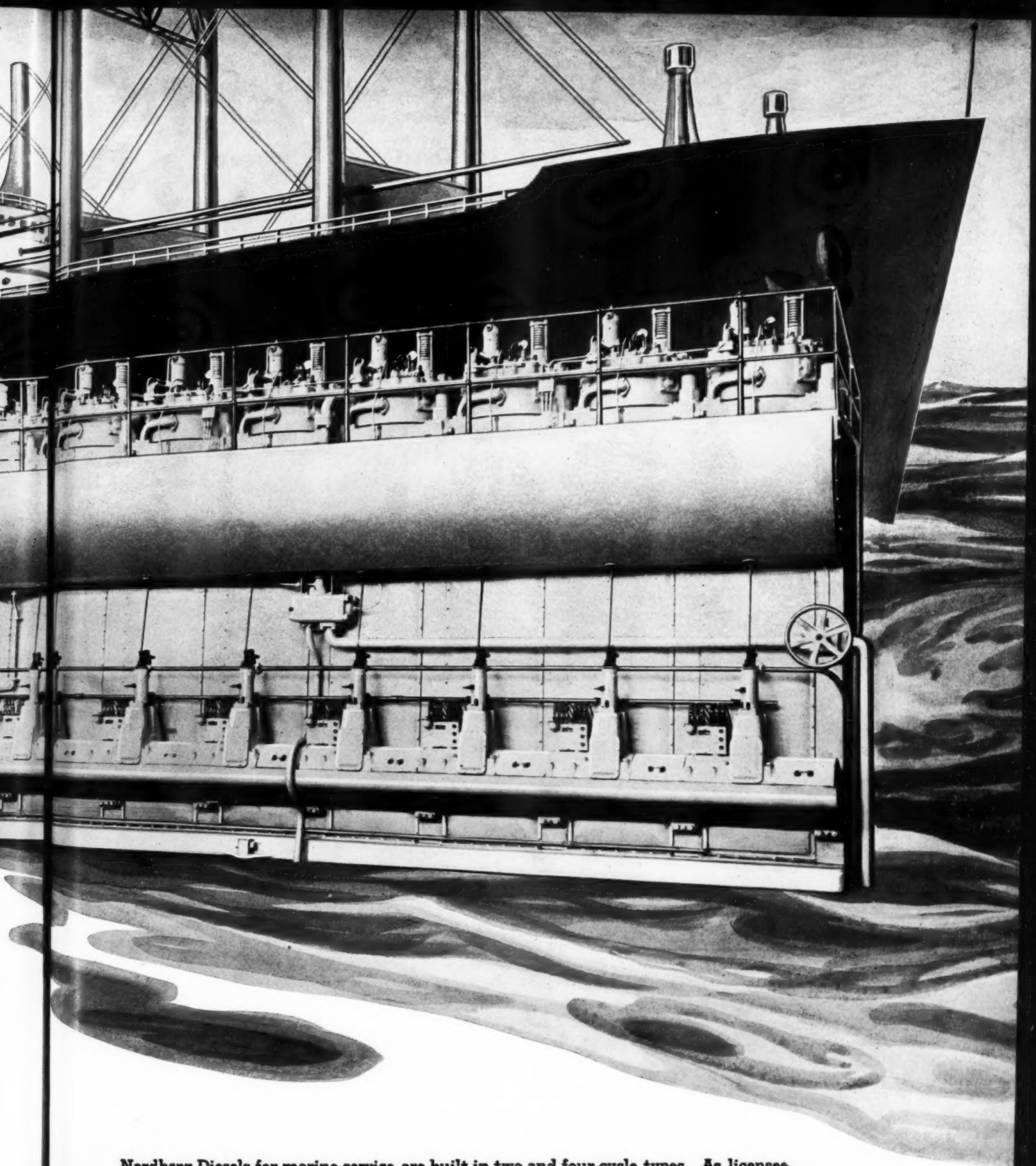
NORDBERG DIESELS

FOR C-2 CARGO SHIPS

Nordberg Diesel Engines will propel four more C-2 cargo vessels to be built for Tampa Shipbuilding & Engineering Company for the account of the United States Maritime Commission. The two engines in each vessel are connected to a single propeller shaft through hydraulic couplings and a gear reduction unit developing the normal shaft horsepower of 6000 at 225 R.P.M. engine speed with 92 R.P.M. propeller speed. Each of these engines of nine cylinders develop 3150 brake horsepower and are of the mechanical injection type, single acting, two cycle, direct reversible and fitted with crossheads. They are exact duplicates of the eight engines now built or building under a previous contract from the same ship yard and also for the United States Maritime Commission.

NORDBERG MFG. CO. **MILWAUKEE, WIS.**

NORDBERG MARINE D



Nordberg Diesels for marine service are built in two and four cycle types. As licensee for Burmeister & Wain, the combined experiences and designs of Nordberg and this well known European Builder are available to users of Marine Diesels in this country.

E DIESEL ENGINES

NEW UPPER COLUMBIA RIVER DIESEL TUG "KEITH"

By CHAS. F. A. MANN

CLAIMED to be the first "Open River" type tug ever built, the twin Enterprise Diesel engined *Keith* is by all odds unique in design and performance. She is the result of many attempts to create a vessel that would operate in the wild upper reaches of the Columbia River toward the mouth of the Snake River, at Wallula and Pasco. Here the Columbia is uncanalized between the Celilo Canal and Umatilla; the corkscrew channel and the velocity of 9 to 10 knots at certain river stages call for a specially designed craft and a cat-like type of navigation not yet found in a rule book or on charts.

Imagine a tug powerful enough to handle two to four 300,000 gal. oil and gasoline or 500 ton wheat barges both up and down river in such going; supple enough to turn about in a circle, the diameter of which is one and one-half times the ship's length; with a hull capable of bouncing off rocks without damage—and you have a general idea of this remarkable craft, the *Keith*.

She is of all welded steel construction, having ⅜ in. shell plating on bottom and bilges, 5/16 in. topsides, and ¼ in. decking. Her length is 92 ft. 6 in., width 25 ft. 6 in., and molded depth 6 ft. 6 in. with a draft of only 3 ft. 8 in., displacing 151 gross tons. The full tunnel stern affords almost complete protection for the twin screws. Extending through the center of the hull for a distance of 75 ft. is a hollow welded stiffening member 2 ft. wide, reaching up to the level of the main deck, which provides storage space for 5,000 gallons of fuel oil, 100 gallons of lube oil and 600 gallons of fresh water.

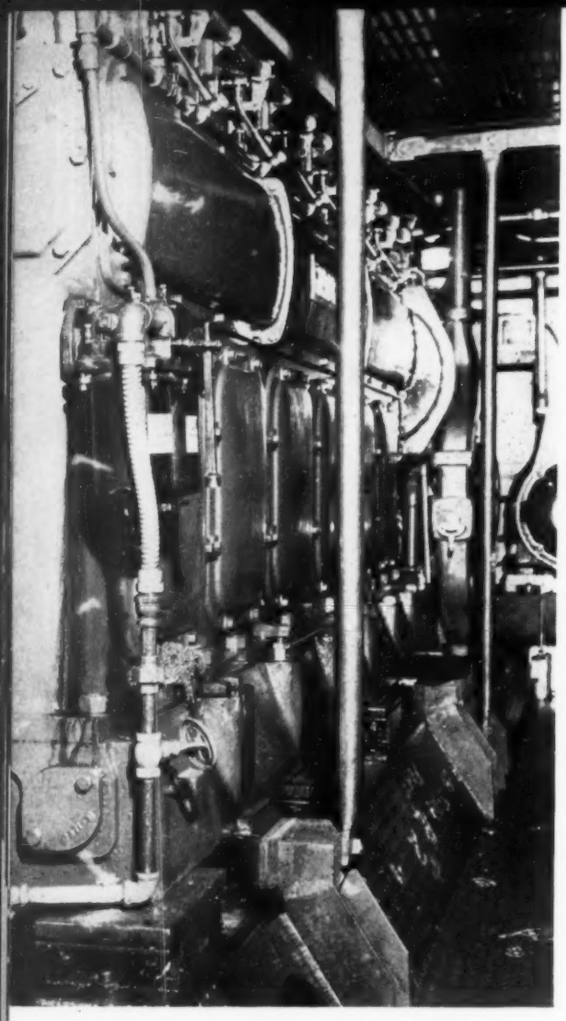
On either side of the longitudinal girder amidships are the two watertight machinery spaces. Herein are installed twin Enterprise, 6-cylinder, 12 in. bore, 15 in. stroke, direct reversing Diesel propulsion engines which, with their Swiss-made Buchi superchargers, develop 1,000 hp. each at 650 rpm. Each engine is controlled from three points on the ship: the engine room control

Captain Leppaluoto at one of the dual control stations in the pilot house on the "Keith." Each station carries a full complement of gauges, a Weston tachometer and steering lever.

station, a full double synchronized control stand on each side of the broad pilot house and a third control stand atop the pilot house for use in severe weather and in close quarters when a full view is essential. The control stations were supplied by the engine manufacturer. Each of the pilot house control stations include separate sets of gauges for each engine and Weston electric tachometers. The engine accessory groups are made up of Harrison heat exchangers for jacket water and lube oil cooling, Weston electric tachometers, Purolator fuel and lube oil filters, and Curtis air compressors belt-driven from the flywheels. Zero-Lash hydraulic valve tappet clearance takeup systems are used on the engines. The auxiliary unit, mounted forward of the main port engine consists of a General Motors, single cylinder, 27 hp. Diesel, driving a 15 kw. General Electric generator, Curtis air compressor, and rotary deck and fire pumps.

Each main propulsion engine is mounted on ten Korfund steel spring vibro-isolators, five on a side. These isolate the engines from the main

Shop view of the new Enterprise Diesel engine with Buchi supercharger in place. So equipped, this engine develops 1,000 hp. at 650 rpm.



View of starboard main Diesel showing Korfund steel spring Vibro-Isolators. Note also Purolator fuel oil filters.

seatings, thus eliminating transmission of normal operating frequencies to the light, flat-plated hull. Two Thomas flexible couplings on each shaft compensate for any misalignment due to the slight free oscillation of the engines. This modern drive arrangement is well illustrated by the accompanying diagram.

The Enterprise Engine Company devised the unusual and interesting power train hook-up. Just aft of the flywheel, connection is made to the forward Thomas flexible coupling, then an intermediate shaft which, in fact, is a tube 12¾ in. in diameter and 15 ft. long, connects to the after Thomas flexible coupling, thence to the flange of the Kingsbury thrust bearing, which in turn is bolted to the propeller shaft flange. With this arrangement, complete flexibility of mounting is obtained and critical speeds of a dangerous nature are eliminated throughout the entire speed range from 150 rpm. to 750 rpm.

The whole problem of adequately powering this unusual craft required close correlation of maximum engine stamina and minimum weight. The Enterprise Engine Company undertook this job, basing their design on experience gained in the operation of the Enterprise-powered tug *Mystic* on the Columbia River during the last year. Out of this experience and the conditions to be met evolved a literally new type of heavy duty, easily maneuverable Diesel, weighing only thirty pounds per horsepower.

Four large air storage bottles, carrying 350 lbs. pressure, supply air through a reducing valve at 200 lbs. to operate the unique steering system. This consists of two main rudders operated by an air ram supplied by Klingbeil Oetinger Company and two monkey rudders in the tunnels, forward of the main rudders, operated by Thor air motors.

The *Keith* is distinguished, beside her unusually broad beam, by the high superstructure deliberately planned to give the pilot house the best possible view of the river. On the main deck are crew's quarters for twelve in six comfortable rooms, and upper engine trunk, crew's toilet facilities, and a large galley. The galley has a Deluxe oil burning range and a 20 cubic foot General Electric ice box. The texas contains captain's and engineers' staterooms and guest room, with shower and toilet. Two streamlined stacks end their "upping" at this level, while the pilot house is mounted atop the texas — four "stories" above the river. A fourth rudder control is fixed in the middle of the front window of the pilot house for the pilot to watch his barge ahead through the open glass, or when landing.

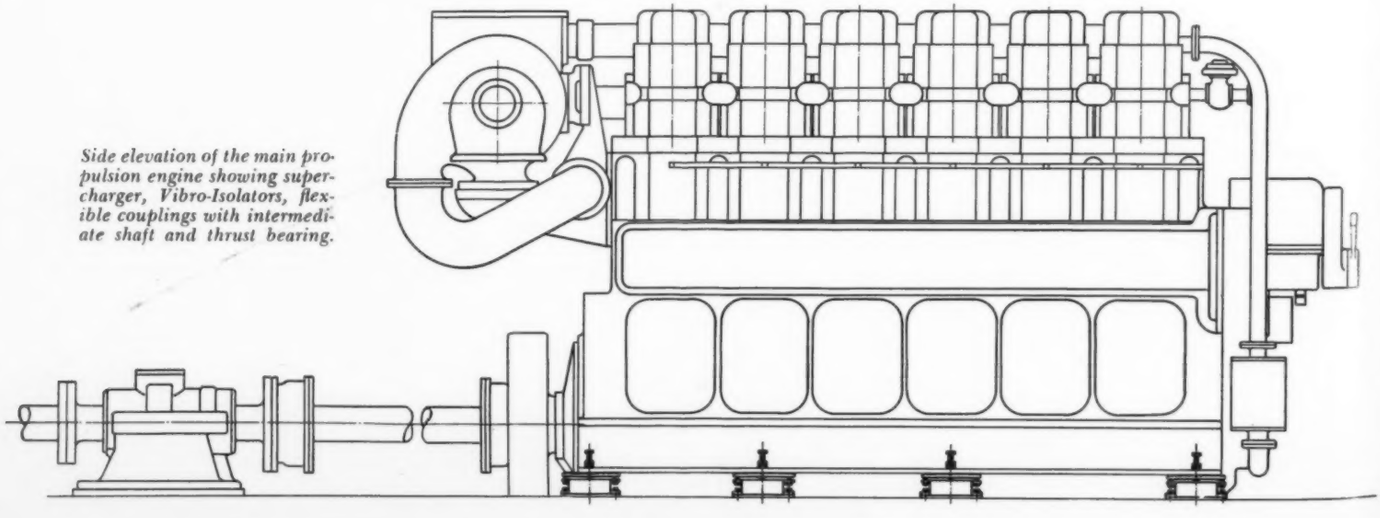
In the upper engine room are the two day tanks, the switchboard carrying a round Alnor multipoint pyrometer mounted on the port side of the forward bulkhead and the gauge board and tool board on the starboard side of the forward bulkhead.

Three Carlisle-Finch searchlights are carried on the upper pilot house, 19 in. size. A Doran air whistle and a two-way radio are carried.

Due to delay in arrival of the superchargers from Switzerland, the *Keith* was put into service for a trial round trip between The Dales, Oregon and Umatilla without superchargers on her two DMG-6 Enterprise Diesels. Under these conditions the engines each develop 600 hp. at 600 rpm. with a resultant speed of 12.9 miles per hour. All concerned with her design and construction, as well as many interested observers, were in fact astonished at the *Keith's* performance on this first trip through the wild waters of the upper Columbia. Probably most pleased of all were Captain A. Leppaluoto and J. L. Hyneman, of the Columbia-Snake River Towing Company, owners of the *Keith*.

Named for Captain Leppaluoto's son, the *Keith* is literally the captain's brain child. It was his experience in navigating the Columbia and in training many young pilots that enabled him to convey to the designer and builder a well-defined set of requirements for this highly specialized craft.

L. H. Coolidge, naval architect of Seattle designed the *Keith*. In charge of construction were Winston Casey, general manager; Willis Tilfer, architect, and Jack Smith, superintendent, and Jay Grebe, marine superintendent of the Commercial Iron Works, Portland.



Side elevation of the main propulsion engine showing supercharger, Vibro-Isolators, flexible couplings with intermediate shaft and thrust bearing.

Hercules Motors Corporation, whose slogan is "The largest builders of industrial engines" held their position. We counted twenty-four exhibitors featuring either Hercules Diesel or gasoline engines in their equipment.

The General Motors Diesel exhibit adjoined that of the Allis-Chalmers tractor space — G-M Diesels are now standard equipment on Allis-Chalmers Diesel tractors. There were twenty-three G-M Diesels dotted around the Show where they would do the most good.

THE CHICAGO ROAD SHOW

THE American Road Builders' Association staged a highly successful Show in the International Amphitheatre, Chicago, from January 29 to February 2 and, in doing so, set the stage for one of the most impressive demonstrations of the manner in which the Diesel engine has come into this vitally important industrial market and taken it over bodily. From one end of this huge show to the other, the word DIESEL confronted you; in practically every exhibit one or more Diesel engines were featured, either in pieces of equipment or as a part of the exhibit. Exhibitors vied with each other in emphasizing the manner in which they were placing the proved economy and established efficiency of the Diesel engine at the disposal of their customers in each and every piece of road building equipment offered and demonstrated. Save with Diesels! Do more with Diesels! Our Diesel occupies less space, has more power, needs less maintenance — that's what you heard, all over that tremendous amphitheatre — a battle of Diesels. And why not? The Diesel engine has built a splendid reputation for itself in the tough, never-ending job of road-building, of road repairing, of road maintenance. For sheer, dogged dependability; for almost unheard of economies, the Diesel engine has delivered the goods, from one end of this country to the other and, for that matter, throughout the world, because American road building equipment is used wherever roads are built today.

International Harvester Company exhibited four brand new Diesel tractors and a complete new line of International Diesel power units. Very heavy emphasis on DIESELS here.

The feature of the Mack Truck e hibit was the big Diesel truck show above and a cutaway model of the six cylinder Mack-Lanova Die engine.

The Buda Company had the large engine exhibit in point of numbe of units shown. A full line of Bud Lanova Diesels was featured.

The Dodge Truck division of the Chrysler Corporation showed their three ton Diesel truck and their six cylinder Dodge Diesel which incorporates Lanova principles of maximum power with minimum pressures.

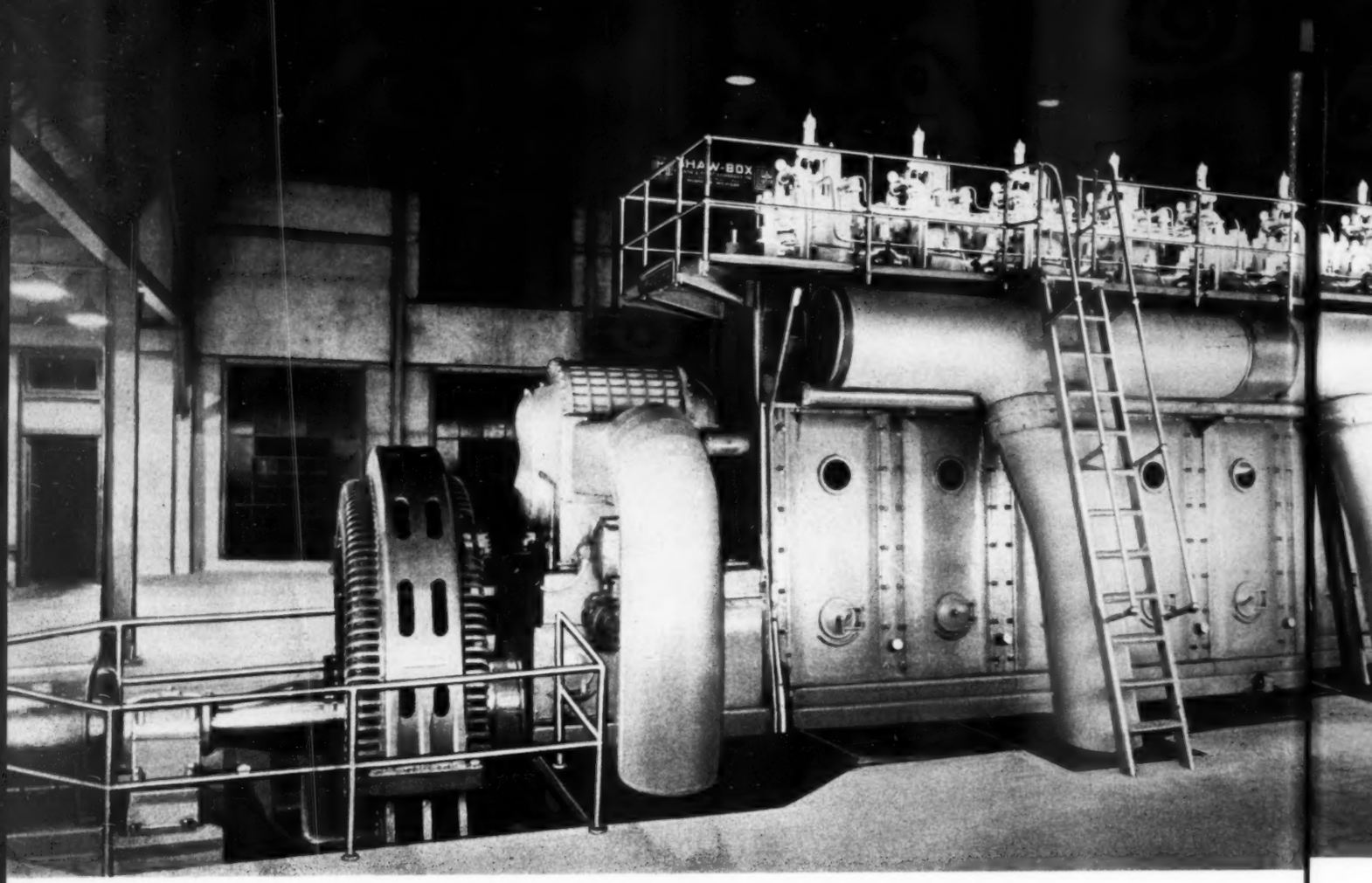
The high spot of the big Cummins Diesel engine exhibit was the super-charged model—this drew real attention and interest the whole duration of the show.

Lister-Blackstone, a newcomer to the domestic Diesel market, exhibited The Lister-Blackstone Power-Pak, a 6 hp. 4½ kw. power unit, and the horizontal Blackstone Diesel.

The news of the show from a Diesel standpoint was the first showing of the Allis-Chalmers tractors with the General Motors two cycle Diesel engine as standard equipment: A complete new line of International Diesel tractors and International Harvester Diesel power units: The first showing of a six cylinder Caterpillar truck Diesel plus a new Caterpillar Diesel tractor, and Cletrac's exhibit of tractors equipped with both Hercules and Buda Diesels.

In the engine section, Hercules exhibited two new units, one of their series of two cylinder Diesels and the other the big six cylinder horizontal or pancake Diesel. Cummins featured their supercharged Diesels and their fuel system. Buda made a fine showing with a full line of Buda-Lanova Diesels and Lister Blackstone, a newcomer, had a fine exhibit. The Lister and Blackstone Diesels are now manufactured in Milwaukee.

Caterpillor Tractor Company startled the trade a bit by exhibiting their new six cylinder Diesel truck unit installed in a four ton truck chassis.



Two views of the big 2,750 hp. Nordberg Diesel. Note, on the intake side shown at the right, scavenging blower, Woodward governor and Manzel lubricators.

DIESEL-ENGINE IRRIGATION

By R. D. COCHRAN*

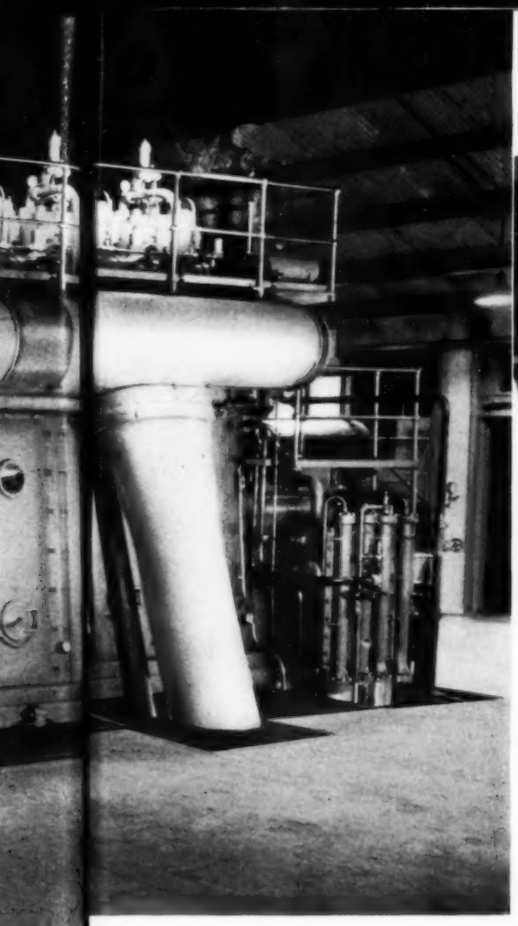
THE San Carlos Project of Arizona is primarily served with irrigation water stored in the Coolidge Dam which was constructed on the upper Gila River in 1927. This water is released through two 6,250 Kva hydro-electric turbines as needed and the power thus generated is sold to industrial consumers and used for project purposes.

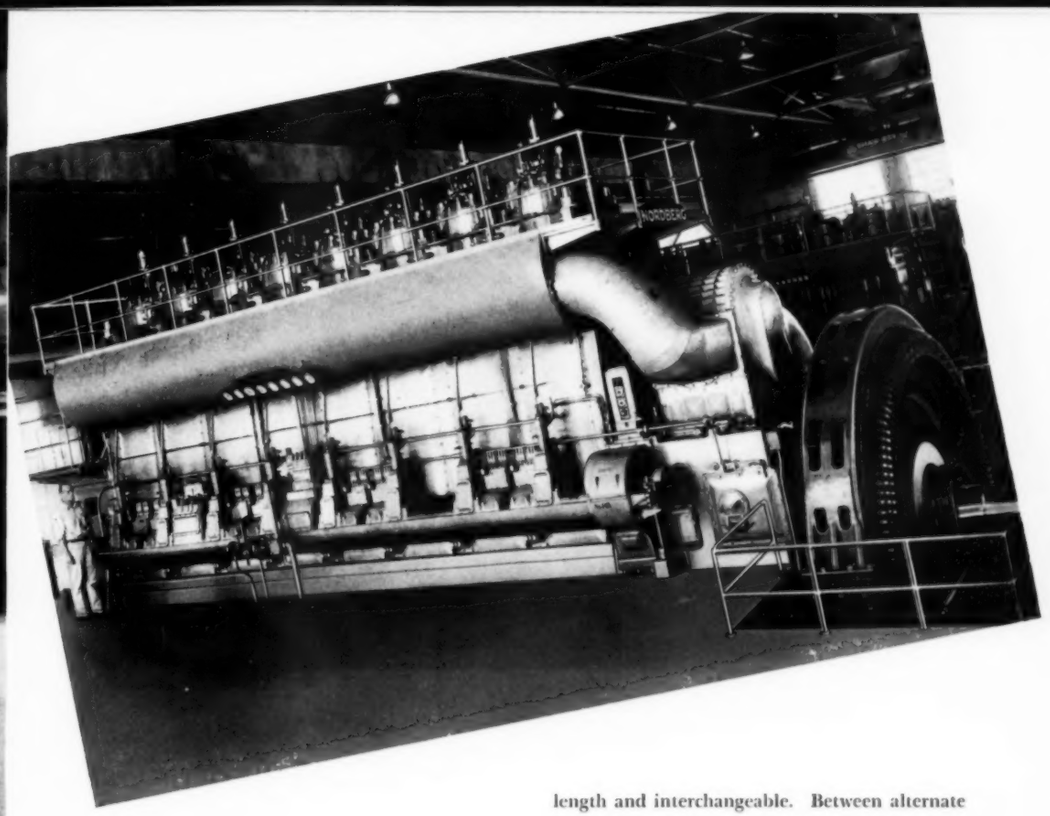
Due to a shortage of stored water, 20 inch drilled and cased deep wells equipped with electric motor driven turbine pumps were installed on irrigation canals during 1933 to augment the water supply. Early in 1934, the need for standby power to supplement hydro-electric power and conserve stored water became apparent and construction of a Diesel-electric station was started on the project by the U. S. Indian Irrigation Service in June, 1935. The original installation of two 1300 hp., Nordberg, 7-cylinder, 16¾ in. bore, 21 in. stroke, TS-177, 2-cycle, solid injection, Diesel engines, direct connected to Elliott, 1165 Kva, 80% PF, 2400 volt, 60-cycle generators was completed in November, 1935.

Greater development of commercial and R. E. A. load so increased the electrical system demands during 1937-1938, that it was again found necessary to increase the power resources of the project's system; so it was decided to install approximately double the original standby capacity of Diesel-electric power.

The proximity of natural gas service lines to the Diesel plant site led Mr. R. G. Hornberger, Senior Electrical Engineer of the Indian Irrigation Service, to include in the preparation of bids and specifications a call for engines using either natural gas or Diesel oil fuel. The Nordberg Manufacturing Company supplied the most satisfactory equipment, meeting all phases of the specifications with their 2700 hp., type TCG-218, 8-cylinder, 21 in. bore, 29 in. stroke, 2-cycle, 225 rpm., Diesel engine, convertible to full Diesel gas-fuel operation. Their

*Superintendant, Diesel Plant, U. S. Dept. of Interior, Coolidge, Arizona





contract included all necessary auxiliaries within the plant building, including generator, switchboard extension, and wiring.

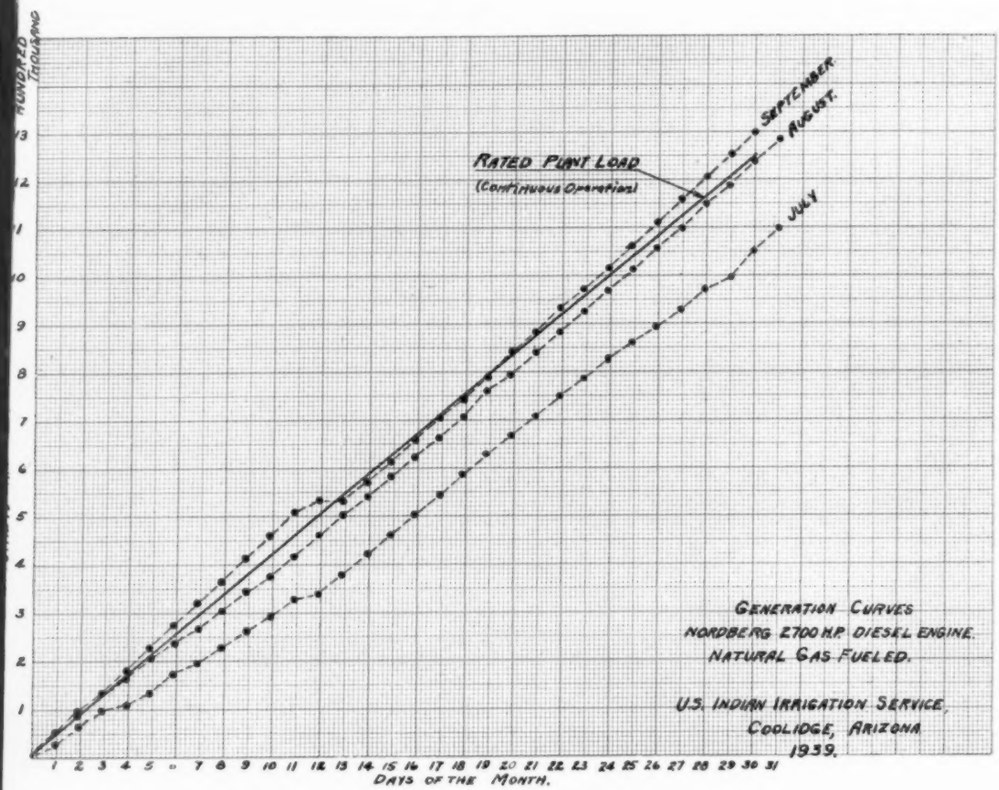
The floor space required for this engine necessitated construction of an extension of the existing building, foundations and cooling system. This work was carried on by the Government through force accounts and separate contracts. The general plan of the original plant construction was followed in this addition but a separate cooling system, including yard piping to and from a new atmospheric cooling tower, was installed. The installation of one Braun Co., type ETI, horizontal oil cooler and two horizontal heat exchangers, connected in parallel, and two DeLaval 410 gpm. centrifugal pumps on each the soft and raw water lines takes care of the cooling of this engine. Closed cooling system is used to conserve treated water.

The lubricating-cooling oil returning from the bearings and piston heads collects in a sump at one end of the crankcase, where it is taken by a gear pump, driven directly from the crankshaft and forced through a duplex Cuno oil filter and through the oil cooler to the engine delivery header. An auxiliary, motor driven, lubricating oil pump with pressure regulator controls so connected that any time during the operation of the engine if the oil pressure drops below a predetermined adjustable value, the auxiliary pump will start and continue to run until the failure is corrected. It is also used to circulate the oil during shutting down or starting of the engine.

The Elliott Company's 2,500 kva., 80 per cent PF, 3-phase, 60-cycle, 2,400-volt direct-connected generator and 35 kw. exciter were constructed with sufficient rotating weight to preclude the use of a flywheel, thus shortening the overall engine length. Scavenging air is furnished by a 14,000 C.F.M. Roots-Connersville blower attached to the engine and directly driven from the crankshaft through gears. The air for scavenging is conducted to the engine by a 28 in. pipe from an air chamber in the building in which the Type S Automatic American Air Filters are placed. In one section of the air duct, a Burgess, Model CA-28, absorption type air silencer was installed to damp out air pulsations. The exhaust headers on the engine and through-floor exhaust ducts, as well as the duct in the basement leading to the muffler outside of the building, were all insulated with one and one-half inch Johns-Manville canvas covered, 85% magnesia.

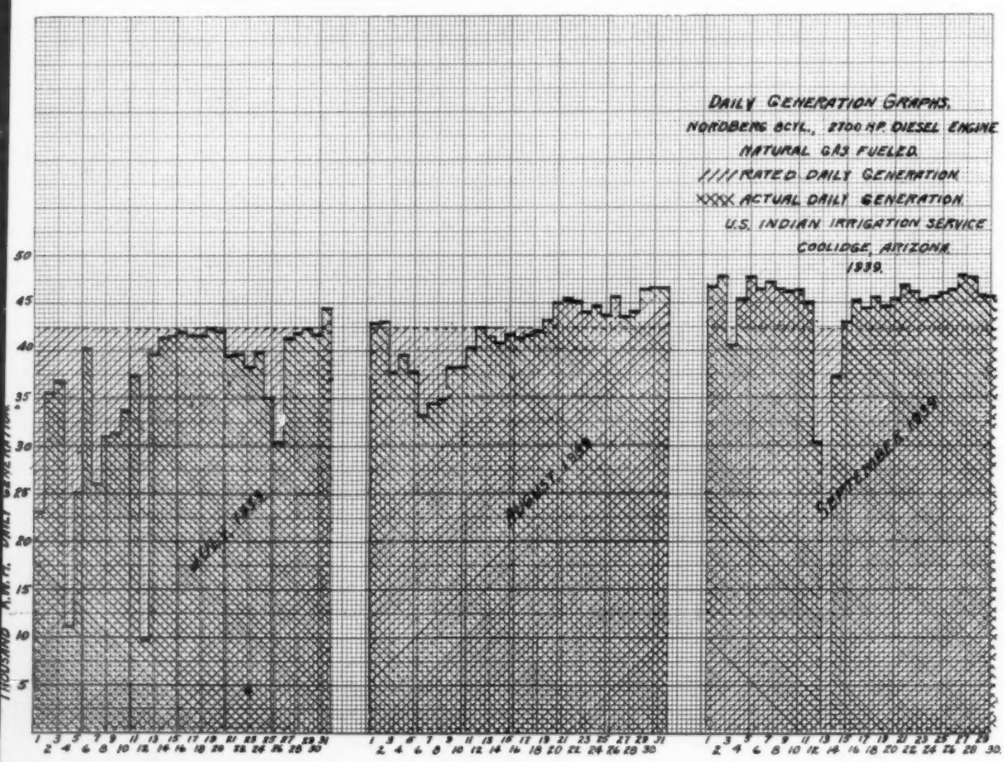
The individual fuel pumps and cylinder lubricating pumps are driven from an engine length camshaft. Each cylinder fuel pump is thus located directly in front of its cylinder and cam-operated from this shaft; all fuel lines from the pumps to the injector nozzles are the same length and interchangeable. Between alternate fuel pumps, two sets of six Manzel force-feed lubricating pumps are installed serving two cylinders; in other words, eight sets of pumps for the eight cylinders and another single set of six pumps for the compressor. They are worm-gear driven direct from the camshaft, thus enabling the engine to operate on timed cylinder lubrication. These fuel pumps, fuel oil injection nozzles and pilot oil pumps are American Bosch equipment.

In changing from oil operation to natural gas fuel operation, the fuel lines and delivery valve from the pumps to the injection nozzles are removed, as are the fuel oil nozzles and cages from the cylinder heads. The gas-fuel injection valves and actuators are installed on the same heads with the actuator pipes connecting the valve actuator to the American Bosch fuel pump. The gas compressor crankpin bearing is installed and the connecting rod of the compressor piston is connected to the crankpin bearing. A set of pilot oil fuel pumps, direct driven from the camshaft, is then timed and a drive chain placed on the shaft gearing for operation. The regular fuel supply is shut off from the main fuel oil pumps and transferred to the pilot oil fuel pumps. The regular fuel pump header is then connected to a small surge tank, filled with medium lubricating oil, located on the engine head deck. This oil is circulated through the regular fuel oil lines on the engine and fed to the fuel injection valve actuators by the large fuel pump of each cylinder, obtaining the time of injection by means of the cam operated pump acting as a hydraulic ram. This actuator oil is



Accumulative generation chart on the gas fueled Nordberg Diesel for one month.

Graph showing the actual output in thousands of kwh. compared to rated power for three typical months' operation.



bled back into the surge tank and circulating system after the actuator has functioned. A novel method of water jacketing the actuator oil lines from the pumps to the fuel injection valve actuators was used to remove the heat developed in the oil by the pump action. This cooling system was connected to the engine cooling water system and discharges into the return header to the heat exchangers.

The pilot fuel oil is injected into the cylinder with the gas charge at a high pressure, developed by the Bosch pilot fuel oil pumps previously mentioned. This eliminates pre-combustion of the high pressure gas and insures complete combustion of the charge.

The gas compressor, located at the opposite end of the engine from the generator, is driven from the main crankshaft during operation on gas fuel, but is disconnected and clamped clear of the shaft and its crankpin bearing removed during oil fuel operation. The compressor takes gas at approximately sixty pounds pressure from a service station located in the plant yard and by three stages compresses the gas to 1100 pounds for blast operation in the engine. Low and intermediate pressure separators and coolers are installed on the side of the compressor crank-case housing. A high pressure gas bottle is connected to the compressor discharge line to float on the engine injection line.

Installation of the engine and auxiliary equipment was started in April and completed on June 1, 1939. The necessary adjustments were made and acceptance tests run on the unit operating as a solid injection Diesel fuel oil engine. It was then converted to gas fuel operation and placed on the lines for regular operation. Acceptance tests on gas fuel operation were made on July 7th and the unit was found to meet requirements with a wide margin of reserve over the manufacturer's claims.

Summing up the operating data: the plant has generated a total of 10,115,800 kwh. with straight Diesel fuel oil and 7,193,000 kwh. with the gas fuel engine, or a total plant output of 17,308,800 kwh. for the year 1939.

A summary of the plant operation for the first 10 months of the year gives an average plant cost per kwh. of $0.004865. However, taking a four months' period covering July, August, September and October when costs of both were available, the average operation cost per kwh. for the solid injection oil engines was $0.00524 with only 3,058,100 kwh. generated as against $0.003305 for the gas engine with 4,962,000 kwh. generated.

DIESEL SERVES SECOND GENERATION

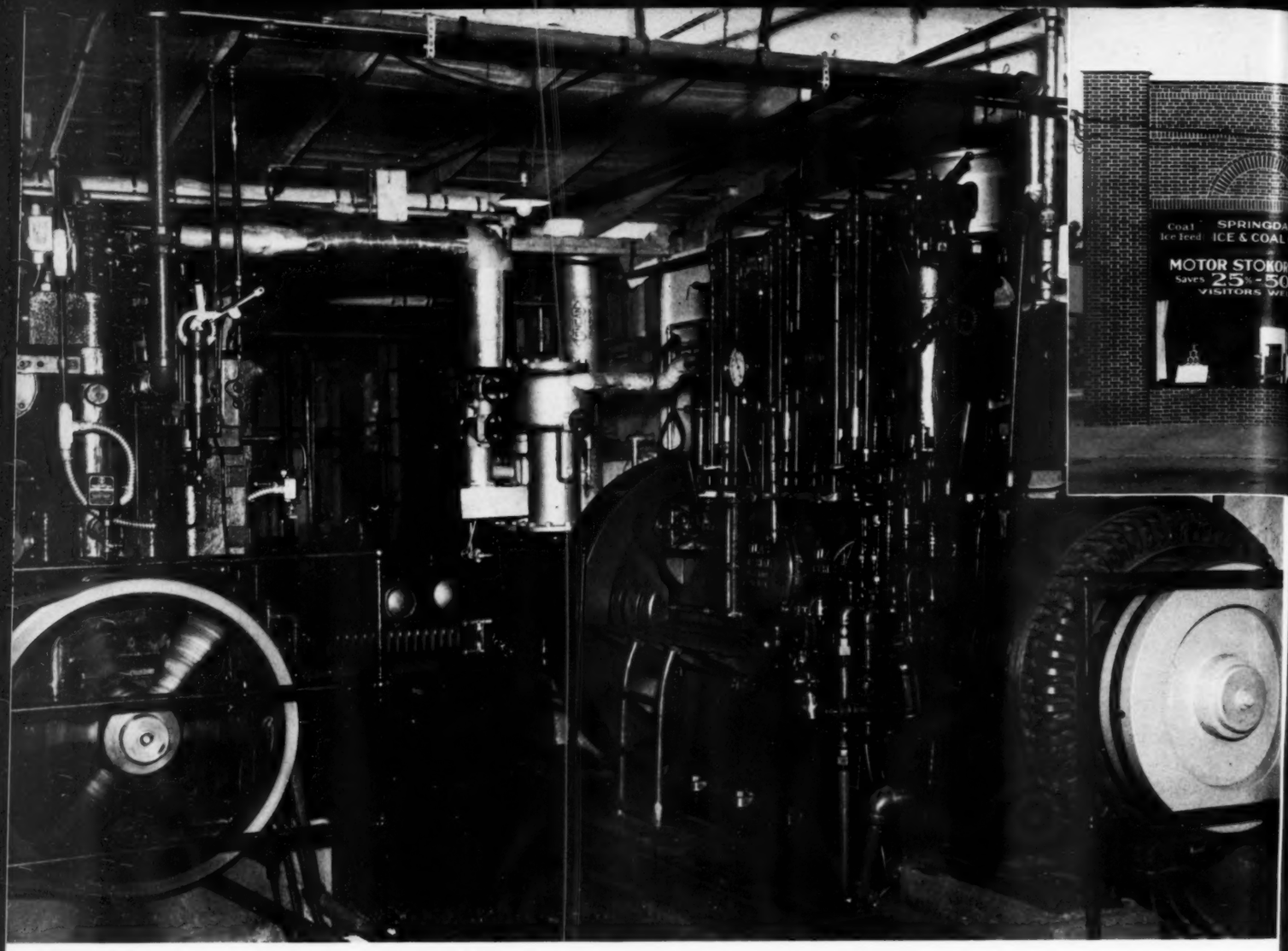
By WILL H. FULLERTON

THE Grandsons of the founders of the Goodwin-Gallagher Sand and Gravel Corporation, together with Mr. James Murphy, formed the Gallagher Brothers Sand & Gravel Corporation a few years ago. Their ancestors of the first generation, dating back eighty years, started with sail boats and schooners, loading and unloading with wheelbarrows, but with the march of time employed a dozen tugs operating from points on Long Island, the greater part of which were equipped with Fairbanks-Morse Diesel engines and auxiliary machinery.

Having learned about tugs and Diesel engines from their father, the present Gallagher Brothers Corporation removed the 500 hp. steam engine from the tug *J. M. Woodworth*, formerly the property of the Federal Government, in the Public Health Service. This was replaced with a Fairbanks-Morse 7-cylinder, Model 37E14, 805 hp. Diesel main engine with built-in compressor, rotary lube oil pump and reversible centrifugal pump for salt and fresh water. The part which the Gallagher boys' grandfather played in the early days of the sand and gravel business always fascinated them, and, as a result, they have named the tug after him, calling it the *John Murray*. This 84.8′ x 20′ x 10′ iron tug now operates at 12 mph., using a Ferguson 3-blade propeller, turning over at 300 rpm. Aside from the advantage of speed, the boat has more power and the installation is complete, including the Fairbanks-Morse 20 hp. Model 36 – 4¼ x 6, marine Diesel auxiliary, which drives a V-type air compressor, a centrifugal pump for bilge and general water service, and a 4 in. Viking rotary lube oil pump, as a standby. Another source of electricity is provided by a 25 kw., 110 volt A.C. generator, driven from the tail shaft of the main engine by V-belts. When in port, electricity is available from storage batteries.

Henry Bade, Gallagher Brothers' port engineer, planned a modern and efficient engine room. The upper half of engine room is used as the engineer's station, where the Fairbanks-Morse remote control is installed for operating the main engine. The lower engine room is sealed inside with Masonite, and besides lending a splendid appearance, this provides hull insulation against weather.

Gallagher Brothers also operate a 123 ft., 800 hp. steam tug and a recent comparison of overall operating costs indicates that the *John Murray* with its Fairbanks-Morse 805 hp. Diesel is doing similar work at 50 per cent lower operating cost. The Gallagher tugs *Barretto* and *Setauket* are also powered with F-M Diesels.



General view of the power plant, showing the two Atlas Diesels, each connected to a York compressor on one end and electric generator on the other.

ICE PLANT SOLVES POWER COST PROBLEM

Small Producer Meets Competition With Diesels

THE Springdale Ice & Coal Company, Inc., of Springdale, Connecticut, is representative of small power consumers throughout the United States in many respects, but particularly is it typical of innumerable independent business organizations that have insufficient volume to earn the preferential power rates of larger competitors. This differential in plant capacity, however, in no way eliminates the necessity of meeting competitive prices despite the premium on power, which constitutes a major item of manufacturing expense. This problem was further complicated by the requirements of intermittent service during slack months when utility demand charges made it most uneconomical, if not prohibitive, to operate for brief periods only, thereby incurring power costs completely out of proportion to actual production as a result of fixed minimum electrical charges. The seasonal character of the ice business, together with the rate premium on the basis of lower

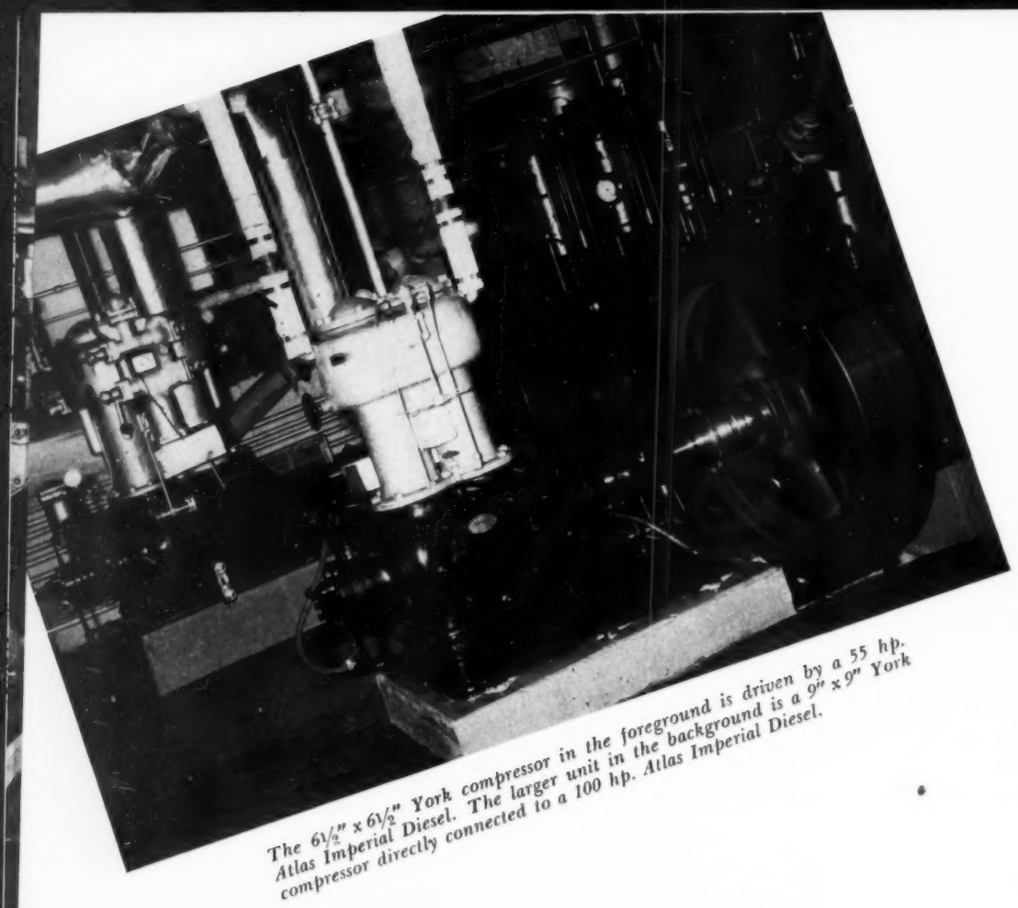
The modern quarters of the Springdale Ice & Coal Company are typical of its progressive management which has been supplying all power demands since 1935 with Atlas Diesel engines at a saving of almost $20,000 over purchased power.

Top — Much time is saved in retail sales by the installation of the automatic ice vending machine. These children have inserted their dime and received a twenty-five pound cake of ice without requiring any attention on the part of the employees.
Above is general view of the tank room at the Springdale Ice & Coal Company as a group of six 300 pound tanks are being withdrawn. The room has a total capacity of 486 three hundred pound cans. The storage room is directly beyond and connected by the door at the right.

power volume in comparison with competitors, forced Mr. G. B. Knapp, president of the Springdale Ice & Coal Company, to seek ways and means of reducing this item of manufacturing cost. His solution to this universal problem should be of interest to many executives faced by similar circumstances.

Twenty-two years' experience in operating his plant (1913 to 1935) emphasized to Mr. Knapp the importance of a dependable as well as economical power supply. With these two considerations in mind, he investigated possibilities open to him and decided upon Diesel drive. The first engine to be installed was a 3-cylinder, 100 hp., Atlas Imperial Diesel, which was placed in service operation in May, 1935. This unit is directly connected to a 9″ x 9″ York ammonia compressor at one end and an Electric Machinery Company generator at the other, which supplies current for the usual motor-driven pumps, compressors, hoists, and other machinery typical of this business. Since it was not necessary to increase plant personnel, an accurate comparison of Diesel versus purchased power costs is easily computed by estimating the latter from records of previous years, and adding up actual charges for Diesel fuel, lubricating oil and maintenance. For the period of two years from May, 1935, to June, 1937, power costs were reduced from approximately $8,000 to $2,290.21 or a saving of 65 per cent. During this time no standby service was maintained nor was production interrupted except for normal shut-downs to permit routine engine maintenance.

On the basis of this record, and to accommodate a demand for increased plant capacity, a second Diesel-generator-compressor unit was installed and placed in service operation in June, 1937. This was a smaller 3-cylinder Atlas engine rated at 55 hp. and direct-connected to a 6½″ x 6½″ York compressor and, through V-belt drive, to a Westinghouse generator. Operation on the basis of this increased capacity proved equally economical. Over a two and a half-year period from June, 1937, to December, 1939, Diesel fuel, lubricating oil and maintenance charges totalled $5,683.11 as opposed to approximately $18,750.00 had the plant operated on purchased electric power. In this period, also, with both engines operating, no interrup-



The 6½" x 6½" York compressor in the foreground is driven by a 55 hp. Atlas Imperial Diesel. The larger unit in the background is a 9" x 9" York compressor directly connected to a 100 hp. Atlas Imperial Diesel.

tions in ice production occurred other than the previous mentioned routine maintenance. At the end of 1939, the first engine has operated a total of 18,234 hours; the newer and smaller unit a total of 7,084 hours.

In analyzing the previous operating figures, it should be noted that fuel and lubricating oil charges were compiled from actual bills paid; hence, are exact cost figures. The remaining item of maintenance, however, was arbitrarily figured on the basis of approximately 4½c per ton of ice produced to build up a reserve for normal repair and replacement in the future. This figure does not represent actual money spent on machinery maintenance during the years against which it is charged. The total summation for both periods is as follows: During a period of 4½ years of Diesel operation, 22,257 tons of ice were produced at a cost of $7,972.32. Had the Springdale Ice and Coal Company operated on purchased electric power during that period, power cost would have totalled $26,708.40 on the basis of the same production and at the rate they were receiving previous to installation of the Diesels. Thus, the total saving amounts to $18,736.08. Mr. Knapp reports that both engines have paid for themselves in addition to earning a substantial net profit.

While the ratio of costs is approximately typical of this industry, both purchased power and Diesel-generated-power cost items are somewhat higher than average. The cost of ice manufactured by Diesel engines usually approximates 27c per ton as opposed to 35c in this case. In addition, cost of ice manufactured by purchased power generally averages about 80c per ton as opposed to approximately $1.20 in this case. These discrepancies can be accounted for by considering the facts of the individual case. The plant in question is relatively small in size and production. Hence, either type of power carries a certain premium. The increase in Diesel cost is also attributable to higher than average fuel oil prices, since the most economical grade of fuel has not been available in this locality, and to the higher than normal maintenance reserve that this owner charges against his plant. In fairness to the utility, it should be stated that a lower purchased power rate was placed in effect after this plant was converted, which would normally reduce the figure for this item as given previously. Minimum demand charges and requirements, however, nullify such a saving since, according to the owner, the seasonal character of his business together with the relatively small amount of power consumed make it unprofitable to operate on purchased power. In this connection, the flexibility of the present Diesel-compressor-generator arrangement provides the further advantage of flexibility in operation. The smaller unit easily handles normal winter demands; as the weather grows warmer, the larger unit has sufficient capacity, permitting the other to be shut down; while in the hot summer months both are required. Thus, except for brief periods each year, one unit is always in reserve, which provides an ample factor of safety to guarantee uninterrupted production. In view of the first two years of operation on one engine, this hardly seems necessary but it permits routine overhaul at the convenience of the plant staff and assures the operation of each engine within its most economical load range.

Since this plant is typical of many others throughout the country, a brief general description may be of interest. The Atlas Diesel engines are rugged, heavy-duty units well adapted to this type of service. They require a minimum of auxiliary equipment, the more important items of which are an Alnor exhaust temperature pyrometer, Maxim silencers, Burgess air intake filters and Minneapolis-Honeywell safety controls which automatically shut off the fuel when lubricating oil pressure drops below a safe point or cooling water temperature exceeds a predetermined level. Electric current from the generators operates lights and a score of motor-driven pumps, blowers, hoists, etc., throughout the plant. When both engines are shut down, lighting is supplied by the city circuit. The arrangement of the ice plant proper is well shown by the accompanying illustrations. The tank room has a capacity of 486 three hundred pound cans and the storage room is of approximately equal capacity. Water is pumped from artesian wells at the plant, which is located in a typical residential district. Although some of the output is shipped to wholesale dealers in Danbury, a brisk retail business is conducted in New Canaan, Darien, Stamford, and surrounding communities. For this purpose a motor-driven scorer is maintained and an ice vending machine, by means of which customers can insert dimes at any hour of the day or night and have the proper size cake of ice automatically delivered through a shute, whether an employee is on duty or not.

The figures previously quoted tell their own story of what Diesel economy means to this organization. The saving over purchased electrical power is typical of this industry and other manufacturing plants. Business men faced with competitive price structures, rising labor costs and other fixed charges, over which they have little or no control, still have equivalent savings in power generation at their command.

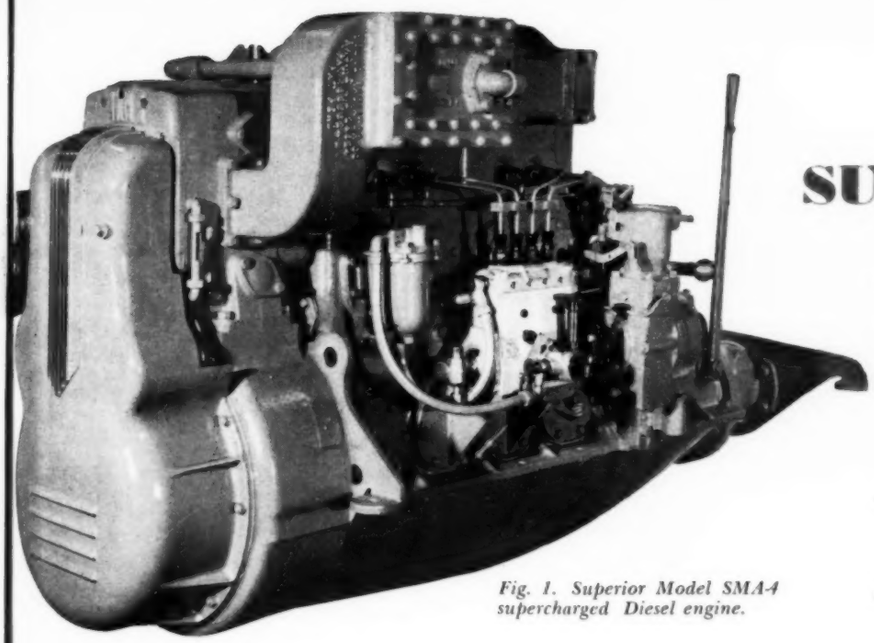


Fig. 1. Superior Model SMA-4 supercharged Diesel engine.

SUPERCHARGING

A Discussion of Robert P. Ramsey's Paper on Supercharging High-Speed 4-Cycle Diesel Engines, Read at S. A. E. Annual Meeting, Detroit, January 19.

By WILL H. FULLERTON

SUPERCHARGING is such an important development in the Diesel industry at the present time that on this and the following two pages we are giving the highlights of the intensely interesting paper prepared and read at the S. A. E. Annual Meeting at Detroit last month by Robert P. Ramsey, Chief Engineer, Philadelphia plant of the National Supply Company.

In his paper he gave details of the early experiments with various types of superchargers on the standard Superior Diesel engine with a bore of 4½" and stroke 5¾". Essentially, of course, these experiments were aimed toward producing the maximum amount of power for the minimum amount of weight, not forgetting long life and satisfactory engine performance.

The Diesel engine is recognized to operate at higher combustion pressures, in general, than the gasoline engine and a somewhat heavier engine than the gasoline engine structure is required. Supercharging, together with higher speeds, is the way to take out of the Diesel engine greater power output and get back the cost of the extra weight of the material involved in the Diesel structure. It is desirable that at all speeds, the supercharger should deliver a fixed displacement per revolution in order that some semblance of a normal compression pressure curve will exist. Compression temperature is vital in the Diesel for ignition purposes. Compression pressure usually bears some relationship to maximum pressures in a given Diesel engine with a given combustion and injection system and it is, therefore, desirable and necessary to keep the compression pressure curve as nearly normal in form as possible. A centrifugal blower with fixed single speed relationship would be effective only throughout a very narrow speed range. Any adjustment made in engine compression ratio to accommodate high speed operation and output would not be operative at lower speeds with a centrifugal blower in a Diesel engine.

An important premise is that combustion pressures in a supercharged engine with properly adjusted injection and combustion will not exceed those of an unsupercharged engine. That premise was proved correct by Mr. Ramsey's laboratory work. A 50 per cent or 60 per cent increase in B.M.E.P. will add nothing to maximum stresses in the engine structure and the positive displacement blower will make possible such an increase at high rotative speeds as well as medium and lower rotative speed by off-

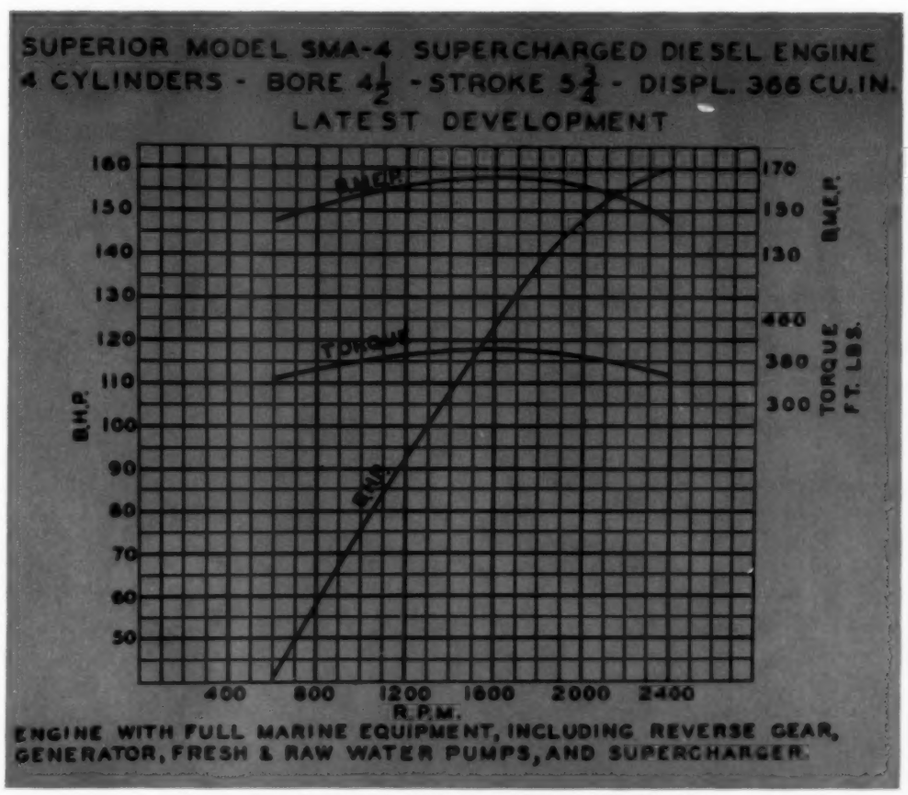


Fig. 3. Superior Model SMA-4 supercharged Diesel engine.

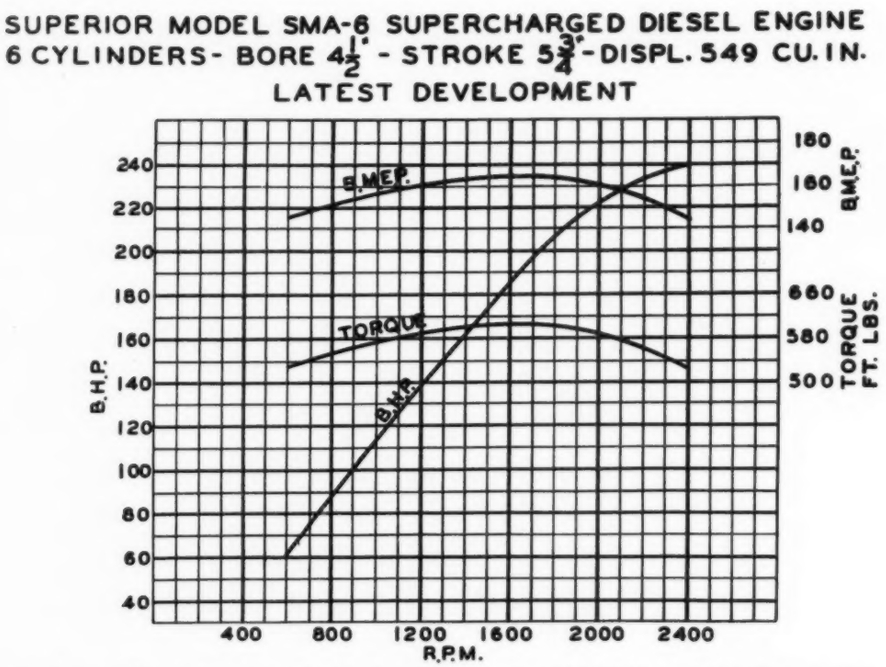

SUPERIOR MODEL SMA-6 SUPERCHARGED DIESEL ENGINE
6 CYLINDERS - BORE 4½" - STROKE 5¾" - DISPL. 549 CU. IN.
LATEST DEVELOPMENT
B.M.E.P.
TORQUE
B.H.P.
B.H.P.
B.M.E.P.
TORQUE FT. LBS.
R.P.M.
ENGINE WITH FULL MARINE EQUIPMENT, INCLUDING REVERSE GEAR, GENERATOR, FRESH & RAW WATER PUMPS, AND SUPERCHARGER.

Fig. 4. Superior Model SMA-6 supercharged Diesel engine.

setting the loss of engine volumetric efficiency as the blower efficiency increases at increased speed. A 50 per cent increase in B.M.E.P. need mean only one or two per cent increase in engine rate of wear as the indicator card is merely widened and not increased in pressure. A few additional crank degrees of sustained maximum pressure result in a great increase of power, but the percentage of wear increase is only a very small amount throughout the 720 degrees of the four cycles.

After various experiments, as stated above, with different types of superchargers, experiments were concentrated on a Roots type unit, mainly because it was possible to buy such a unit from more than one source here in the United States; whilst the other units used in prior experimentation were all made abroad. It was decided that since the initial program of tests in the development of the Superior supercharged four cycle engine had been satisfactory, every endeavor should be made to carry the program through to a successful conclusion. The basic 4½" x 5¾" engine was selected for this purpose and an Aluminum alloy cylinder block, together with a light weight oil pan, Aluminum fly wheel housing, Aluminum heads and manifold. In this connection the research department of the Aluminum Company of America contributed largely to the program.

It was decided that the bearing sizes and crank size in this engine were entirely adequate. In order to reduce reciprocating weight, however, the piston was redesigned and considerably lightened and at the same time the connecting rod was reduced about 30 per cent in weight and the wrist pin was reduced in diameter from 1¾" to 1 7/16".

This engine complete as a marine design with fresh water closed cooling system, reversing gear, raw water pumps and all electric starting accessories (see Fig. 1 and Fig 2), develops 160 hp. at 2,400 rpm. with a Roots type supercharger mounted as indicated in the illustrations.

A stripped automotive engine embodying this construction weighs 1,120 lbs. which amounts to 7 lbs. per horsepower. This design has had nearly 5,000 hours in the laboratory and so successful have been the tests that a supercharged engine of this type is now being put through production for commercial sale.

It is not intended here to name any limitation of maximum speeds of operation for supercharged four cycle Diesels. 2,400 rpm. represents about the top commercial speed of an engine of the type under discussion here; namely, 4½" x 5¾" cylinder size. There is no reason whatever to indicate that peak speeds of 3,500 or even 4,000 are not practical in an engine of smaller cylinder displacement. It is only a step further, and so far as supercharging, combustion phenomena and physical materials are concerned, there seems to be no obstacle.

The National Supply Company's and Mr. Ramsey's present interests are in engines of 4½" bore upward, but the automotive engine

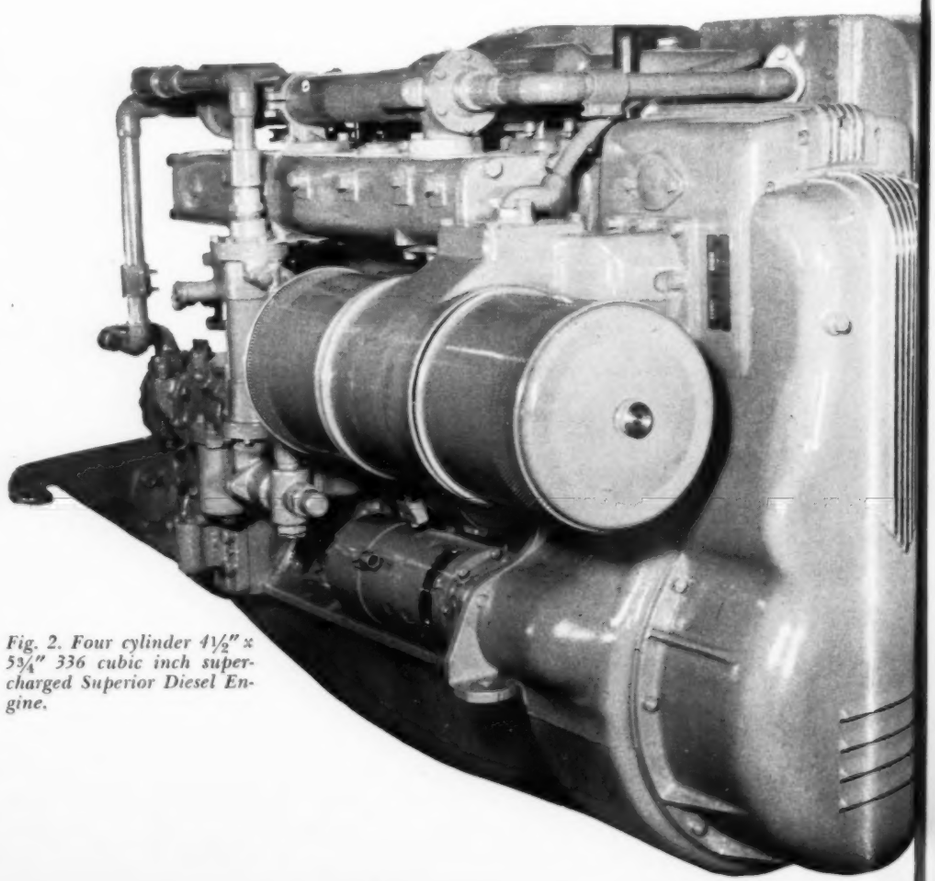


Fig. 2. Four cylinder 4½" x 5¾" 336 cubic inch supercharged Superior Diesel Engine.

builder can readily achieve higher speeds through smaller displacement.

Volumes could be written about the development of the Aluminum alloy cylinder head for high output supercharged Diesel engines of this type. That is a complete story in itself. Correct alloys, heat treatments and constructions had to be worked out to withstand the combination of high pressures with high temperatures and increased heat flow. It is notable that the aluminum alloy head makes possible the use of much higher engine compression ratios and for that reason higher engine output can be obtained with them in a high speed four cycle supercharged Diesel engine than with cast iron.

During the early experiments on the supercharging of this four cylinder, four cycle Superior Diesel, it soon became evident that an air cooler installed between the supercharger and the engine would improve performance. Consequently the Young Radiator Company was called into conference and a heavy duty, core type air cooler using raw water for cooling was designed and built as an integral part of the supercharging layout for this engine. This air cooling unit shows very prominently in Fig. 1. After the installation of this air cooler, horsepower production increased to as much as 18 hp. on a six cylinder engine.

The supercharger itself has undergone considerable evolution. The design now in production is streamlined, jacketed, and is quite noiseless when properly air silenced. It is very reliable and little or no maintenance is required. By referring to Fig. 3, the net result of the experiments on the Superior Model SMA-4 supercharged Diesel engine produced a maximum of 160 hp. at 2,400 rpm. On Fig. 4 it will be seen that the Superior Model SMA-6 supercharged Diesel engine produced a maximum of 240 hp. at 2,400 rpm. In Fig. 5 a comparison is given between the power production of the four cylinder Superior Diesel supercharged and the same engine unsupercharged, emphasis being made on the point that combustion pressures, exhaust temperatures, and fuel economy were the same at the two points indicated on the chart. On Fig. 6 comparison of the Superior six cylinder, 4½" x 5¾" engine is shown as to power output supercharged and unsupercharged.

It seems quite conclusive that the high output, high speed 4-cycle supercharged Diesel engine can be built today on a production basis in a very close cost equality with the gasoline engine. The only remaining element of disproportionate cost in the Diesel is the fuel injection apparatus. Basic simplification is indicated as the correct attack on that problem. Mr. Ramsey has advocated the idea of a single plunger high-speed metering pump for a long time and fully expects to see such a design ultimately placed on the market.

The automotive type Diesel power plant of the future may in all probability be a smaller displacement engine than its gasoline burning competitor and about the same weight per horsepower but it will have better economy.

Supercharging to the Diesel engineer opens up the same possibilities for progress as the advent of superheated steam and high pressure steam offered the steam engineer.

His present research program is directed toward completely noiseless combustion, better economics and to higher bmep. output.

It seems likely from his experience that 200 lb. bmep. 4-cycle may ultimately be attained in a commercial engine.

At the present time higher bmep.'s are attained in aircraft engines for take off where fuel economy is secondary. Similarly aircraft Diesel engines are built in much lower weight per horsepower than the weights indicated herein. Aircraft practices, however, in the matters of output and weight are not intended to come within the scope of this discussion.

It is also extremely interesting to note that, in cases of high speed automotive types engines of smaller displacements, the weight per cubic inch increases and somewhere below the cylinder size discussed in this paper the weight per cubic inch between gasoline and Diesel approaches the same value. This is set by the foundry and other practical factors instead of actual stressing. Furthermore higher compression ratios, supercharging and high octane fuels may bring the gasoline engine weight and cost per horsepower to a point which will be about the same as the supercharged high speed Diesel.

Mr. Ramsey thinks that the two engines can ultimately arrive at the same point so far as weight per horsepower and cost of production are concerned in a commercial engine but when that time arrives, he believes it will have been found that the Diesel will excel in simplicity and operating economy.

Non-evaporative lower grade fuels probably will have an advantage over high octane gases from many points of view and it may develop

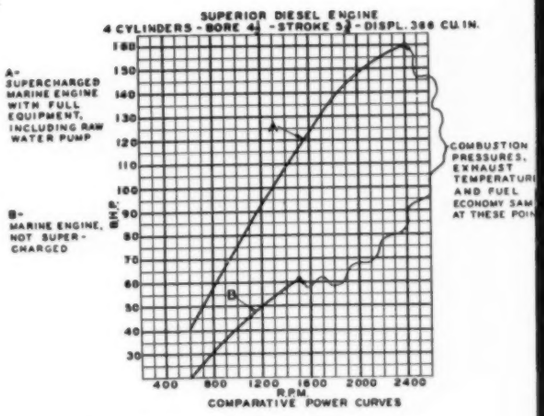

SUPERIOR DIESEL ENGINE
4 CYLINDERS - BORE 4½ - STROKE 5¾ - DISPL. 366 CU.IN.
A- SUPERCHARGED MARINE ENGINE WITH FULL EQUIPMENT, INCLUDING RAW WATER PUMP
B- MARINE ENGINE, NOT SUPER-CHARGED
BHP
RPM
COMBUSTION PRESSURES, EXHAUST TEMPERATURE AND FUEL ECONOMY SAME AT THESE POINTS
COMPARATIVE POWER CURVES

Fig. 5. Four cylinder Superior Diesel supercharged and unsupercharged.

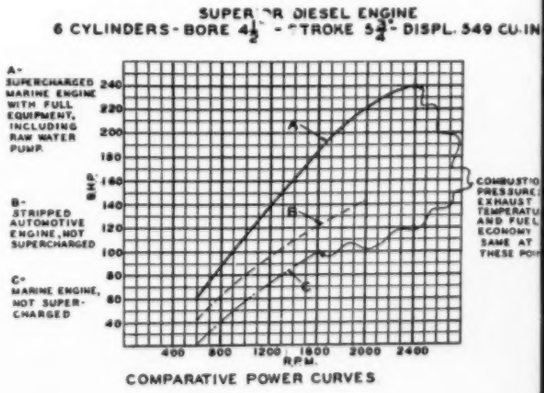
that different objectives require both types of engines.

It seems likely that the high output gasoline spark ignited engine, either with carburetion or injection, the 2-cycle scavenged Diesel and the 4-cycle supercharged Diesel are all converging to one point so far as weight per horsepower is concerned. Physical and thermal maximum limitation also indicate a convergance toward the same point of maximum commercial performance.

It will remain for the economics of first cost, operation, and durability to shape the internal combustion engine's future.

Mr. Ramsey's paper as given at the S.A.E. annual meeting at Detroit was so interesting that a whole morning session was devoted to it. Of necessity, this article brings out but the highlights of his paper, so we recommend to our readers that they write for the complete paper, addressing The Society of Automotive Engineers, 29 West 39th Street, New York, and remit fifty cents for Robert P. Ramsey's paper on "Supercharging of Diesel Engines."

Fig. 6. Six cylinder Superior Diesel supercharged and unsupercharged.


SUPERIOR DIESEL ENGINE
6 CYLINDERS - BORE 4½ - STROKE 5¾ - DISPL. 549 CU.IN.
A- SUPERCHARGED MARINE ENGINE WITH FULL EQUIPMENT, INCLUDING RAW WATER PUMP.
B- STRIPPED AUTOMOTIVE ENGINE, NOT SUPERCHARGED
C- MARINE ENGINE, NOT SUPER-CHARGED
BHP
RPM
COMBUSTION PRESSURES, EXHAUST TEMPERATURE AND FUEL ECONOMY SAME AT THESE POINTS
COMPARATIVE POWER CURVES

CROSBYTON, TEXAS

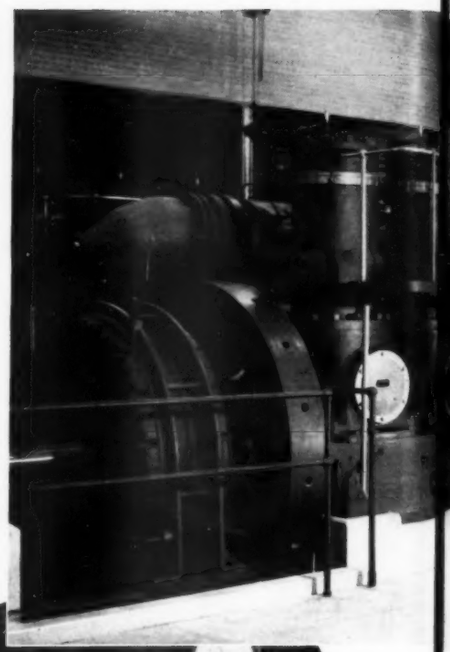
By A. V. REITER

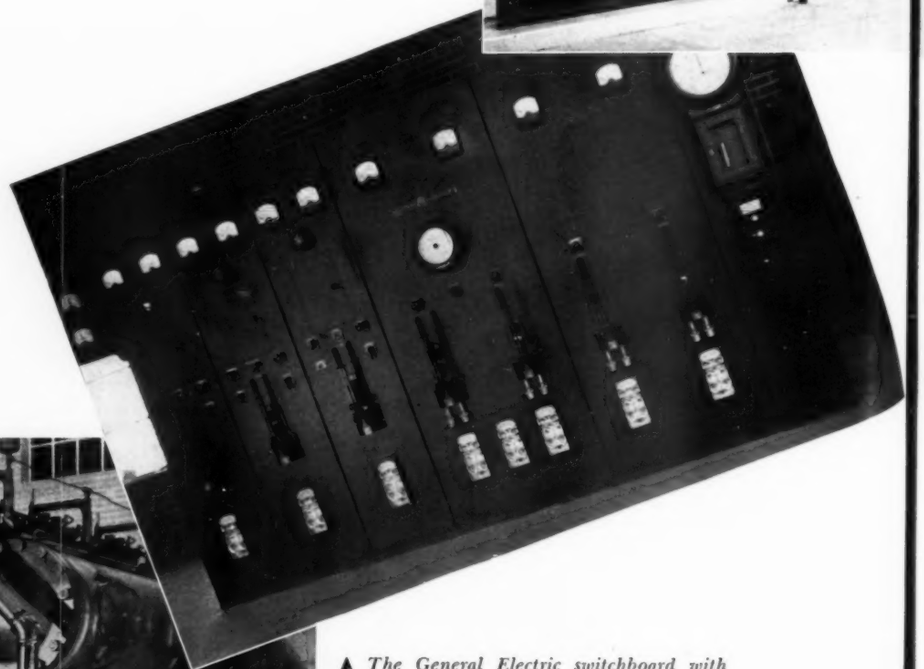
ON the south plains of the Panhandle of Texas, the small City of Crosbyton may be seen for many miles at night from any point of the compass. Its 103 brilliant street lights, the majority of which are 6,000 lumens each, line every principal street adding to Crosbyton's name as a prospering town in the great wheat and ranch section, the distinction of being the best lighted town of its size on the far-reaching plains. The ambition of Crosbyton to own and operate its light plant has been realized with the installation of two new 225 hp. Fairbanks-Morse Model 32 E14 and one 120 hp. Fairbanks-Morse Type VA Diesel engines. The latter engine was in the existing municipal ice plant, and now all are used in the new municipal light and power plant.

The practicability and economy of municipal ownership is not new to the citizens of Crosbyton, now celebrating the 30th anniversary of its founding. In the late '20's the town installed a Diesel ice plant. It was one of the few city-owned ice plants in the Southwest, and among them it is outstandingly successful. This past year's operation of the Diesel ice plant paid the city a net profit of $2,240.27. Following progressively, then, in the knowledge of the earning power of the Diesel, Crosbyton began formulating plans for a homeowned light and power plant. The foresight and keen practical sense of the West Texans were realized with the installation of the Crosbyton municipal plant and the beginning of its operations in December, 1939.

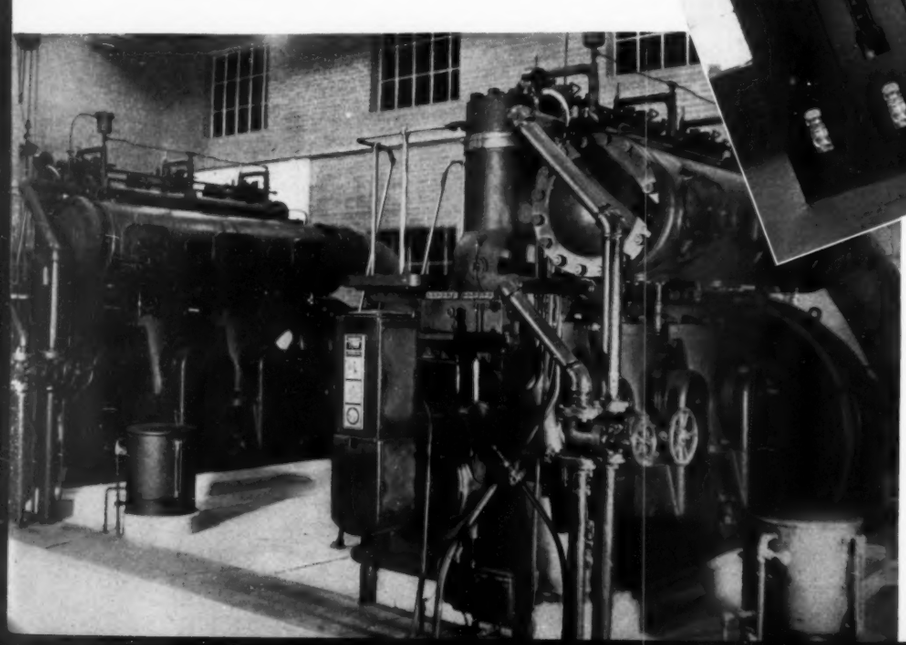
When the switch was thrown, the Diesels began their first day of service to Crosbyton with 60 per cent of the business of the city. An estimate made by the engineers and bondholders of the average annual expense of the plant is $7,000. With only 60 per cent of the business, not allowing for natural growth in the city or possible extension into the rural sections, the City of Crosbyton will reap a net profit of $6,800. With 80 per cent of the business, which the officials expect, the net profit will be $11,400. The anticipated 80 per cent looks very possible inasmuch as after only 30 days of operation the municipal light plant has 260 of a possible 350 meters hooked up, carrying 74 per cent of the total business.

The three units installed consist of two 225 hp. and one 120 hp. Fairbanks-Morse Diesel engines



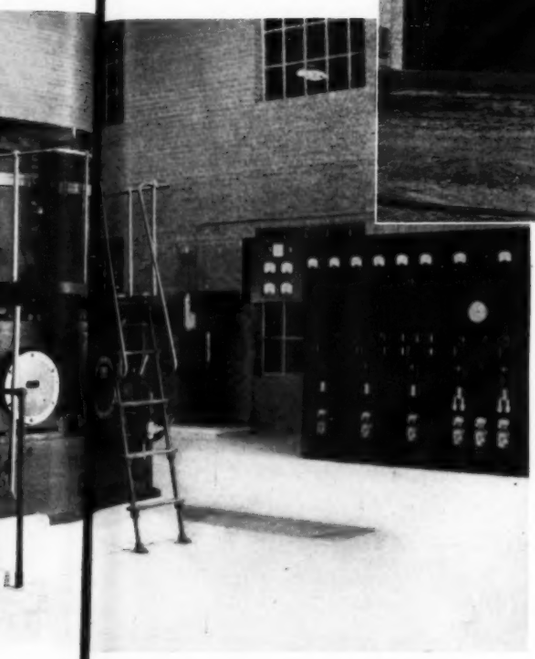


↑ *The General Electric switchboard with totalizing panel at extreme left.*



← *Interior view of the new power plant building showing the two Fairbanks-Morse 225 hp. Diesels equipped with American OCH air filters.*

Exterior of the Crosbyton Diesel electric generating plant with the Water Equipment Corporation cooling tower.



General interior view showing the switchboard and one of the two Fairbanks-Morse Diesel engines and generators.

of the heavy duty slow speed type. Each engine is direct connected to Fairbanks-Morse engine type alternating current generators and with suitable "V" belt driven exciters. The three units supply the City of Crosbyton with a total of 380 kw. at 80 per cent power factor. A three-unit plant of this size is ideally suited to give the city a very good running load factor. On peak loads one 225 and one 120 hp. unit will be operated. On intermediate loads through the day the 225 hp. unit will be utilized. On the off-peak load that occurs from 12 midnight to 5:30 A.M. the 120 hp. unit will supply the demand for current. Under such an arrangement one 225 hp. unit will serve as standby in case of repairs and routine check of each unit.

Crosbyton has the added advantage of owning its water system. By operating the water pumps a great deal of the time on the normal off peak periods, the plant is further assured of a good load factor. The specifications called for the two new Diesels to operate at not less than the following guarantees:— full load .38 lbs. of fuel per bhph.; three-quarters load .39 lbs. of fuel per bhph.; one-half load .44 lbs. of fuel per bhph. Certified fuel oil consumption tests show that these engines exceeded the requirements.

The two new Diesels, 225 hp. each, are equipped with Woodward governors, Nugent oil filters, and a Multipoint Alnor exhaust pyrometer located on the switchboard. The lubricating oil is reconditioned by a type SHVA Goulds Hydroil. Lube oil is Sinclair Rubeliene. Air to the engines is filtered through American OCH type filters. An overhead trolley and hoist built by Chisholm Moore Hoist Corporation serves the engines.

The cooling tower is constructed of all heart California redwood of the deck and spray nozzle type made by the Water Cooling Equipment Corporation. The tower is equipped with heat exchangers, made by the same manufacturer, which are in the basin and have soft water circulating through them, giving a closed cooling system and eliminating the scaling of engines caused by raw water circulated directly through the engine jackets. Water circulating pumps are in duplicate — two for soft water and two for raw water. They are built by Fairbanks-Morse and are of the built-together type which have splash proof motors driving centrifugal pumps. Each pump is designed for a maximum of 300 gpm. against a total pumping head of 50 feet.

Other automatic devices assist in the upkeep of the Diesels. If the water becomes low or excessively hot, or pressure drops, warning is given by an automatic siren alarm. The lubricating oil which flows from one central tank flows through the engines only once before entering a filter where it is cleaned. Fuel oil is delivered in truck load lots at a cost of 4c per gallon delivered. Piping is installed in a very neat and useful manner, and Crane valves are used throughout. Pressure gauges in the piping are furnished by Marsh.

The switchboard and instruments are of General Electric manufacture, of the very latest type with voltage regulators, totalizing meters, graphic voltmeter, and telechron clock. The board is deadfront with all necessary panel switches and instruments.

Duplicate air starting units are installed comprising an engine driven and electric motor driven compressors. A battery of air tanks built by Diesel Plant Specialty Company is located adjacent to the air compressors.

The exterior and interior of the power plant building is very attractive, well ventilated and lighted, and kept clean and neat by an efficient staff of operators under the direction of Mr. Hugh Nation, manager of City Utilities.

Now that the City of Crosbyton owns and operates its light plant, it is realizing immediately other benefits: better lighting of the streets, definite physical improvement of the community by the addition of the new home-owned building that houses the Diesel generating units, added employment, elimination of the $915 annual city bill to the private power company, and the increase of earning power without increasing taxes.

HERE'S THE *BIG NEWS* YOU'VE BEEN WAITING FOR

CUMMINS Dependable **DIESELS**

War

100,000 MILES

The Cummins Engine Company bases this warranty on the records of the thousands of Cummins Dependable Diesels sold during the last eight years, all of which, with a few exceptions, are now in use. These Cummins Dependable Diesels have a combined operating record of more than 150,000,000 miles . . . a record unequalled by any other manufacturer of automotive diesels. That's why we can confidently make this warranty . . . that's why we say: "The job YOU want done is NOW being done with Cummins Dependable Diesels."

THESE CUMMINS DIESEL *firsts* ARE YOUR PROTECTION

first—The Cummins Diesel was the *first* economical, cold starting, flexible, high-speed, tested and proved diesel to be offered to truck operators. Its eight-year record of performance has established its outstanding leadership in diesel value.

ANOTHER ***first*** The Cummins Diesel is the first diesel with a record of more than 1,000,000 miles on single engines.

ANOTHER ***first*** The Cummins Diesel is the first diesel among fleet operators, from coast-to-coast, who now have combined mileages of more than 150,000,000 miles on their Cummins Diesel-powered trucks.

SHOULD YOU BE SATISFIED WITH ANYTHING LESS THAN

rranted

ENOR ONE YEAR

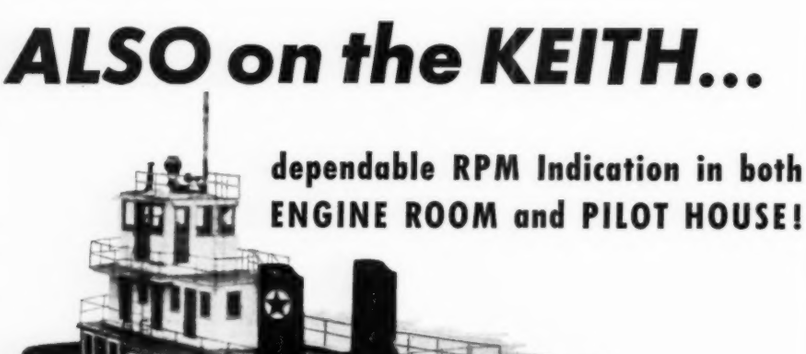
ANOTHER ***first*** The Cummins Diesel was the first diesel to demonstrate its economy on BOTH long and short hauls . . . an all-over economy that includes not only more miles per gallon of cheaper fuel, but less maintenance, service and parts replacement.

ANOTHER ***first*** The Cummins Diesel was the first diesel with a fuel distribution and injection system exclusively its own . . . 100% American in design and manufacture.

AND NOW ANOTHER ***first*** The Cummins Diesel is the first diesel to offer the purchaser *a guarantee* for one year or 100,000 miles. The Cummins Engine Co., Columbus, Indiana.

HE *first* DIESEL IN VALUE AND PROVED PERFORMANCE?

ALSO on the KEITH...



dependable RPM Indication in both ENGINE ROOM and PILOT HOUSE!

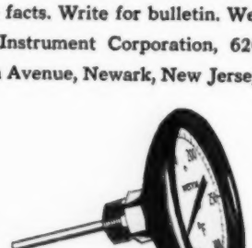
WESTON ELECTRICAL TACHOMETERS

WESTON Indicators are available in various sizes and shapes, with scales calibrated in any range of R.P.M.

The KEITH, like other modern Diesel tugs, has RPM indicators mounted *where they're needed!* There are two in the engine room ... one for each engine ... with duplicate indicators for the pilot up in the wheel house. » » » It's electrical indication, of course; for remote and duplicate indication is only practical the electrical way. There is no flexible shafting involved. The indicators are simply wired to the magneto ... the wiring easily run through existing conduit. And there are other advantages to electrical indication, such as smooth, readable pointer action – dependable accuracy – and long service. Be sure you have all the facts. Write for bulletin. Weston Electrical Instrument Corporation, 620 Frelinghuysen Avenue, Newark, New Jersey.

WESTON all-metal gauge-type DIESEL THERMOMETERS

Rugged, all-metal construction. Readable gauge-type scales. Temperature element encased in rigid, stainless steel stem. Available in stem lengths from 2½ to 24" ... scale diameters 3 to 6". Accuracy ... within 1%. The ideal thermometer for all Diesel needs. Send for literature.



WESTON ELECTRICAL INSTRUMENT CORPORATION

FIRST NATION - WIDE INVENTORY OF DIESELS USED IN FACTORIES

By A. W. VON STRUVE*

NOT only will the 1939 output of Diesel engine makers be reported in the Census of Manufactures now under way, but, even more important to the Diesel field, all factories in the country are being asked for data on the Diesel and semi-Diesel engines they have in use or available.

Since January 2, census enumerators have been bringing to the manufacturers a questionnaire to be filled out, containing an inquiry on power equipment. This calls for a listing of the number and total rated horsepower of Diesel and semi-Diesel engines, with a separation between prime movers driving generators and prime movers not driving generators.

When the answers to this query are tabulated, it will be the first time this information on Diesel use has ever been available. Nation-wide statistics on power equipment were published by the Census Bureau for 1929, but at that time Diesels were not common enough to warrant separate study.

Just about the time that field work is being completed on the Census of Manufactures, the Census of Agriculture opens on April 1. This census also will produce information important to the Diesel field.

The operators of seven million farms will be asked whether their dwellings are lighted by a home plant, and whether there is an electric distribution line within one-quarter mile of the dwelling. The resulting statistics, the first ever collected by the Census Bureau on the subject, will have an obvious usefulness to marketers of Diesel electric plants for farm home use.

Also significant will be the tabulations of number of tractors on farms, and year of latest model. The latter point is being covered for the first time, and will indicate the number of farms with tractors nearing the stage of obsolescence, constituting a potential market for replacement with Diesels.

Basic census facts will be published by late summer or early fall, with detailed analyses following as rapidly as possible, depending on the promptness with which returns are received.

*U. S. Department of Commerce, Bureau of Census.

HERCULES BOOKLET

A VERY concise, yet comprehensive explanation of modern high-speed, heavy-duty Diesel engines is covered in a new booklet just issued by Hercules Motors Corporation of Canton, Ohio. Handled in question and answer form, some very interesting comparisons are presented between Diesel engines and gasoline engines; also, between the two-cycle and four-cycle types of Diesel engines. The complete line of Hercules two-cylinder, four-cylinder and six-cylinder engines is shown, including the Hercules Complete "Power Package" Replacement Diesel for Ford Trucks for the years 1935 to 1940, inclusive.

THE Diesel Power & Machinery Company, with offices in Chicago, Memphis, New York and Los Angeles, announces a new loose-leaf type of perpetual catalog which is available to individuals and companies interested in used Diesels, power machinery and equipment. This catalog will furnish up-to-date information on the machinery available and as motors are added to the line, or are sold, such information will go out to those holding the perpetual catalog. Thus it will always be a ready reference for those desiring the best in used Diesel equipment or other powered machinery.

CATERPILLAR FUEL SYSTEM

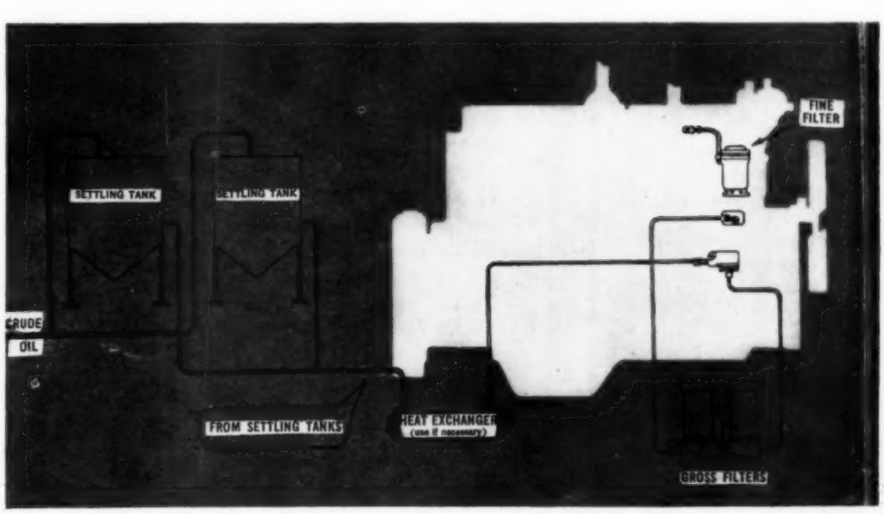
A SPECIAL crude oil burning fuel system has been developed by Caterpillar Tractor Co., and is now available for all 5¾ in. and 5¼ in. Caterpillar Diesel engines. Extensive laboratory and field tests have proven the system highly satisfactory.

In the new Caterpillar system, crude oil passes from settling tanks through a heat exchanger to the fuel transfer pump on the engine. From the pump, it goes through a gross filter up to the standard engine fine filter. From there it passes through the fuel injection pumps into the fuel injection valves, and into the cylinders of the engine.

Settling tanks are recommended with the system to lessen the filtering required by the gross filter. When using these tanks, the fuel should be allowed to settle for at least 48 hours, and two or more tanks should be used, each of sufficient capacity to supply fuel for at least 48 hours of operation.

The gross filter removes the major amount of the remaining dirt and abrasives from the oil. It consists of two compartments approximately 18 in. high by 8 in. in diameter, mounted on a base which also acts as a manifold for the oil. Each compartment contains two large filter elements, which can be easily replaced when necessary. A pressure gauge on the outlet side of the filters indicates when this should be done. A gauge is also used on the inlet side of the filters to indicate whether or not there is sufficient pressure on the fuel. A valve permits using only one compartment or both together, as desired, and the elements in either compartment may be changed without shutting down the engine.

The crude oil injection equipment is the same in design as the standard Caterpillar Diesel fuel system. However, it is made of corrosive-resistant steel and has certain differences making it applicable to crude oil use. Like the standard Diesel fuel system, it has absolutely no operating adjustment. It provides satisfactory combustion throughout the entire speed and horsepower range of the engine. Performance is equally satisfactory, and is such that the regular Diesel fuel power curves apply to the crude oil burning engines.



Official photograph United States Navy

TRUE TO TRADITION

the United States Navy Fleet Tugs

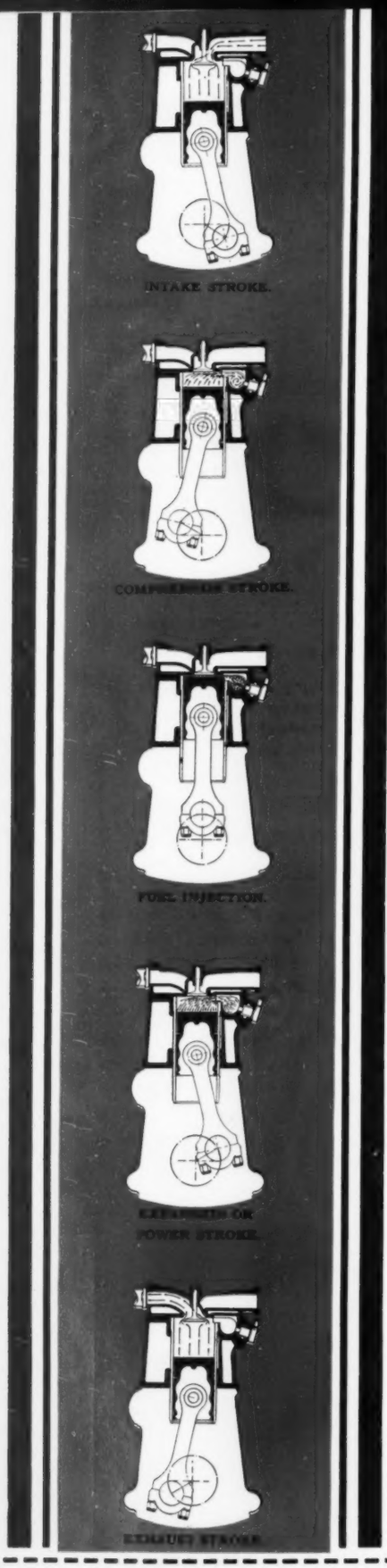
• NAVAJO • SEMINOLE • CHEROKEE

are the finest of their type afloat.

VORTEX Spark Arrester-Silencers on both main and auxiliary Diesels provide superior muffling of exhaust pulsations and positive extraction of sparks and stack solids. As proven by years of service, *VORTEX exhaust units are unequalled for dependability and ultimate operating economy on all types of ships.*

ENGINEERING SPECIALTIES COMPANY, Inc.

39 CORTLANDT STREET NEW YORK, N. Y.



A BOOK ON DIESEL ENGINES

BY REX W. WADMAN

THE greatest living authority on the subject has written one of most intensely interesting and informative books on DIESEL ENGINES ever to appear in print. A big book in every way, 10¼" wide, 13½" long, and 304 pages, beautifully illustrated and printed. Mr. Wadman finished writing this book late last summer; we printed and published it last September. Written in that concise, easily understandable manner which characterizes all his writings, this BOOK ON DIESEL ENGINES contains a detailed description of one hundred and seven different and distinct Diesel engines. Each engine is taken apart for you; its features of design covered in detail; its methods of manufacture described for you with a clarity of expression never previously approached.

This BOOK ON DIESEL ENGINES by Rex W. Wadman is a welding together of a wealth of experience, and a tremendous enthusiasm for the subject. Nothing like it published. The most useful Diesel book available, supplying, as it does, a complete cross section of the whole industry insofar as the engines available are concerned. The BOOK ON DIESEL ENGINES by Rex W. Wadman is of inestimable value to the Consulting Engineer; the Naval Architect; the Shipyard; The Diesel Salesman; The Diesel Designer; Prospective Diesel Engine Purchasers; and Diesel Engine Owners and Operators. A file cabinet, full of authentic, up-to-the-minute technical data on ALL available Diesel Engines: accurately, compactly compiled for YOUR benefit.

DIESEL ENGINES DESCRIBED

Alco Four Cycle Stationary
Alco Universal Type
Alco-Sulzer "T" and "TM"
Allis-Chalmers
Atlas Imperial
Atlas-Lanova
Bristol "Phoenix" Diesel
Buckeye Diesel
Buda-Lanova Diesels
Busch-Sulzer Bros. 2-cycle
Busch-Sulzer Bros. 4-cycle
Caterpillar Industrial Engines
Caterpillar Marine Engines
Chicago Pneumatic Model 8-CP
Chicago Pneumatic Type RHB
Chicago Penumatic RHB-100
Clark Bros. Diesels
Clerget Aviation Diesel
Coatalen Aviation Diesel
Cooper-Bessemer Type EN and GN
Cooper-Bessemer Type JTB
Cummins Diesels
De La Vergne Type VA
De La Vergne Model VB
De La Vergne Model VE
De La Vergne Model VG
De La Vergne Model VM
De La Vergne Gas Engines
De La Vergne Model VO
Deschamps Aircraft Diesel
Diesel Marine Auxiliary Units
Dodge Diesels
Enterprise Diesels
Fairbanks-Morse 33 and 37
Fairbanks-Morse Model 36-A
Fairbanks-Morse Model 36-A-8
Fairbanks-Morse Model 42-E
Fairbanks-Morse 32 and 35
Fairbanks-Morse Model 38
Fairbanks-Morse Model 46
General Motors Model 71
General Motors Model 567
Gray Marine Diesels
Guiberson Aviation Diesel
Hall-Scott "Chieftain"
Hamilton M.A.N. Engines
Hercules Diesels
Hill Diesels
Ingersoll Rand Type "S"
International Harvester
Junkers Jumo Diesel
Kahlenberg Engines
B.M.W. Lanova Diesel
Lister Small Stationary Diesels
Lorimer Diesels
Mack-Lanova Diesels
Mercedes-Benz
Murphy Diesels
Napier Culverin Diesel
Nordberg 4-cycle Diesels
Nordberg 2-cycle Diesels
Nordberg Gas-Diesels
Power Manufacturing Company
John Reiner Units
Ruston-Hornsby Horizontals
Sterling Crankless Diesel
Stover Single Cylinder Diesel
Superior Model "A"
Superior Model "D"
Superior Type M
Superior Type S
Titusville Iron Works
Venn-Severin Model "D"
Victor Horizontal Type
Washington Iron Works Diesels
Waukesha-Hesselman Type
Witte Types
Worthington Diesels
Yankee Diesel
Z.O.D. Aviation Diesels

MAIL TODAY

DIESEL ENGINES, INC.—Two West Forty Fifth Street—New York City.

Enter my order for a copy of A BOOK ON DIESEL ENGINES by Rex W. Wadman, for which I enclose $3.00. I understand that the sub-title of this book is "Diesel Engine Catalog" and I further understand I can return the book to you, in good condition, within ten days of its receipt by me, for full credit, if it doesn't meet my requirements.

NAME_____

ADDRESS_____

_____

Please print name and address

DALLAS RAILWAY AND TERMINAL COMPANY PLACES EIGHT DIESEL-ELECTRIC BUSES IN OPERATION

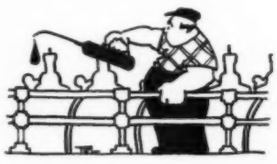
THE Dallas Railway and Terminal Company recently placed eight Mack-General Electric coaches in operation on their Love Field Line in Dallas, Tex. These 41-passenger Diesel-electric coaches replace 35-passenger gasoline coaches operating from downtown Dallas through a good residential section and then through a fast growing industrial section to Love Field, the municipal airport crossroads of the Coast to Coast and the Great Lakes to the Gulf Airlines. Loads are heavy on both inbound and outbound buses along this route.

BUDA APPOINTS NEW SALES ENGINEER

MR. R. K. MANGAN, Vice President of The Buda Company of Harvey, Illinois, has announced the appointment of Mr. L. H. Crafts as sales engineer in charge of Marine Engine Sales in the Eastern territory.

Mr. Crafts was for several years employed by The Lycoming Manufacturing Company and more recently was sales manager of their Marine Division. Prior to his association with Lycoming and after leaving the University of Pennsylvania, Mr. Crafts was in the U. S. Navy, and spent several years in all types of sales and engineering work.

Mr. Crafts will be glad to see all his friends at his new headquarters—The Buda Company office and store at 253 West 64th St., New York, N. Y.



THE Maxim Silencer Company announces the appointment of Eliot W. Higgins as special representative. Mr. Higgins returns to this company after a period of several years' absence during which time he has been identified with the silencing field in all its branches.

The Diesels of Tug "Keith" for "The Toughest Towing Job" Have an ALNOR EXHAUST PYROMETER

THE unique, but immensely powerful "Open River" type tug "Keith," owned by Columbia-Snake River Towing Co. and operated on the Columbia River from Portland to Umatilla, is powered with two new type 1000 hp. DNG-6 Enterprise 12 x 15 Diesel Engines.

Designed to operate in the wild upper reaches of the Columbia River where the rapids are swift and the channel a corkscrew, this tug is called upon to meet unusual conditions.

Every feature in the design and construction of this tug was considered and chosen to meet these special conditions. The armoured hull, the shallow draft, the special type of drive for utmost flexibility, the engine mountings, the main power units all facilitate operation of this outstanding vessel.

To aid the engineers in keeping a close check on the combustion conditions of each cylinder, thus insuring the continuous, efficient, instantly responsive performance, these Enterprise Diesels are equipped with an Alnor Exhaust Pyrometer as shown in the engine room view above.

If you are using Diesel power or are planning an installation, it will pay you to learn more about "Alnor" Exhaust Pyrometers.

Write for Catalog.

ILLINOIS TESTING LABORATORIES, Inc.
423 NORTH LaSALLE STREET • CHICAGO, ILLINOIS

"Alnor Pyrometers"—The ENGINE X-Ray

SIBLEY TO D.E.M.A.

OTIS A. SIBLEY has been appointed Secretary of the Diesel Engine Manufacturers' Association and the offices of the Association have been removed from 2 West 45th Street to Mr. Sibley's office at 205 East 42nd Street. The telephone number is MUrray Hill 4-3637.

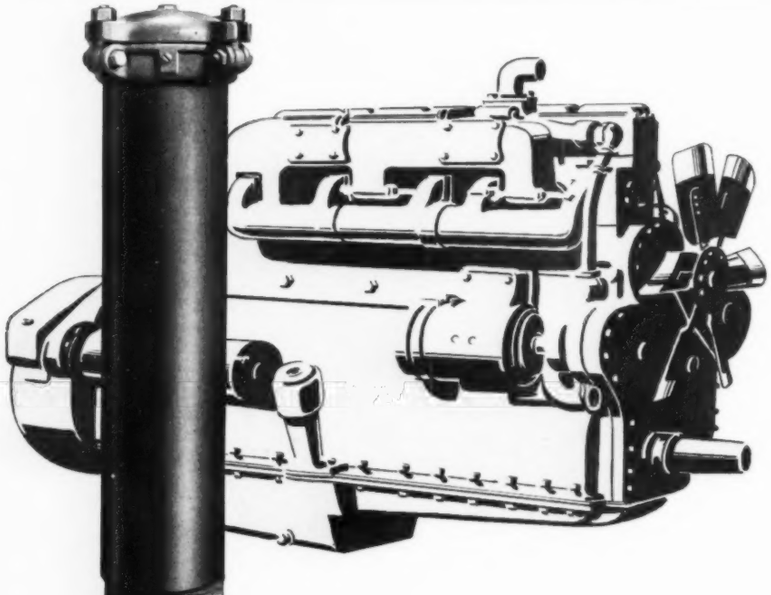
The Diesel Engine Manufacturers' Association is to be heartily congratulated on obtaining the services of Mr. Sibley as its Secretary: his experience and contacts in the Diesel industry peculiarly fit him for this work.

DIESEL CONVENTION TO ASBURY PARK

THE Oil and Gas Power Division of The American Society of Mechanical Engineers has made arrangements to hold its annual convention at the Hotel Berkeley-Carteret at Asbury Park, New Jersey, June 19 to 22.

As in previous years, a room will be set aside for exhibits and a full schedule of interesting papers will be read during the convention.

Further details on the program will appear in DIESEL PROGRESS next month.



STARTLING SAVINGS

During the past several years,—MICHIANA Oil Filters have been responsible for startling oil savings on important Diesel engine equipment . . . . . On high speed trains,—MICHIANA Filters have increased the length of time between oil changes sufficient to pay for the filters in a few days . . . And besides such immediate savings,—better lubrication, reduced maintenance, longer engine life are assured.

For the Diesel engines or Diesel-equipped machinery you buy,—it will pay you to specify MICHIANA Oil Filters, Re-Packable Type,—or write us for infomation on complete range of sizes . . . . . MICHIANA PRODUCTS CORPORATION, Michigan City, Indiana.

MICHIANA

Re-Packable Element

OIL FILTERS

for all Diesel and Gasoline Engines

Re-Packable Element

ATLAS SALES

FLECK ENGINEERING COMPANY, distributors for Atlas Imperial Diesel Engine Co., reports the sale of one 600 hp. Atlas Imperial marine Diesel engine, 6 cylinders, 15 in. bore, 19 in. stroke, to The Edwards Co., Inc., of Reedville, Virginia, for installation in their Menhaden fishing boat *W. L. Messick* to replace steam equipment.

They report also the sale of one 160 hp. Atlas Imperial marine Diesel engine, 6 cylinders, 9 in. bore, 12 in. stroke, 325 rpm., to the W. E. Valliant & Co. of Cambridge, Maryland, for installation in their boat *Marydel*.

HERCULES DEVELOPS WELL-ROUNDED DISTRIBUTOR ORGANIZATION FOR DIESEL REPLACEMENT ENGINES FOR FORD TRUCKS

REFLECTING the growing demand for Diesel engines for small truck applications, Hercules Motors Corporation of Canton, Ohio, has built up an efficient distributor organization for the sale and installation of its Diesel replacement unit for the Ford truck chassis.

The Hercules complete "packaged" unit can be readily installed in the Ford truck chassis for the years 1935 to 1940, including left-hand drive Cab-Over-Engine Models – without any major alterations in the truck chassis.

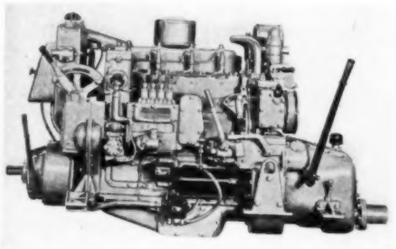
While the Ford Motor Company uses the identical packaged unit in chasses built for export, a Diesel-equipped truck is not offered by Ford in the domestic market or in Canada. All Ford dealers, however, are in position to supply the Hercules Diesel. To better serve the dealers, also the truck owners, Hercules distributors have been established principally in Ford Motor Company branch cities – where engines are installed and where parts and equipment are quickly available for servicing the engines. Twenty-two of the thirty-four Ford branch cities in the United States now have Hercules distributor representation. The total number of Hercules distributor points at present is thirty-one with a few key locations still to be covered.

Operating records show that exceptional economies result from the use of the Hercules Diesel when installed in truck or tractor-trailer units hauling profit-producing payloads over sufficient mileage.

CATERPILLAR MODEL D3400

ROUNDING out its line of Diesel marine engines, Caterpillar Tractor Co. of Peoria, Ill., has announced the 25 hp. Model D3400.

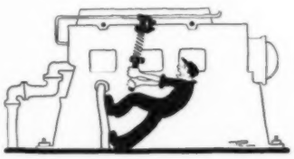
The new engine is especially well suited for lobster, scallop and oyster fishing boats, or for any of the general line of small, open type work boats. It has 4 cylinders, with a bore of 3¾ in. and a 5 in. stroke. Its maximum hp. output is at 1,500 rpm. and its rating is for continuous, sustained service.



The new engine brings the line of Caterpillar Diesel marine engines up to six sizes, ranging from 25 to 135 hp. Like all other Caterpillar models, the D3400 is offered with an auxiliary gasoline engine as standard starting equipment; but is also available with electric starting.

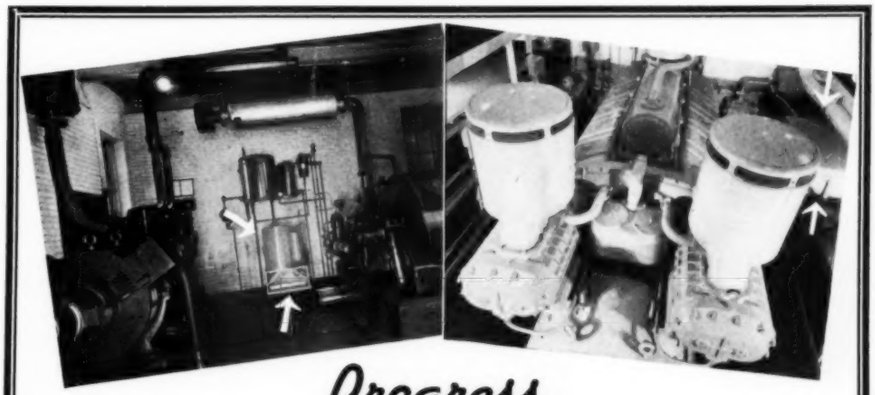
The unit is characterized by unusual simplicity. There is only one operating adjustment — the valves. Fuel injection equipment is entirely factory set, and requires no adjustment on the job. The injection valves are of the single orifice type, and the size of the opening eliminates the need for frequent cleaning.

The D3400 marine engine is available with Twin Disc reverse and reduction gears with ratios of 1.62, 2.36, or 3.2 to 1.00, giving propeller speeds of 926, 635, and 469 rpm. respectively.



FAIRBANKS-MORSE MOVES TO MARITIME EXCHANGE BUILDING

THE New York branch of Fairbanks-Morse & Company, manufacturers of Diesel engines, has taken possession of their new offices in the Maritime Exchange Building at 80 Broad Street, where they now occupy the entire sixth floor. Thomas Drennen, sales manager for the eastern territory for Fairbanks-Morse, is in charge of the office. The telephone number is HAnover 2-7470.



Progress

IN LUBE OIL MAINTENANCE

Above view shows an early model Briggs batch reclaimer installed (two years ago) on a Diesel at The Brunswick Home, Amityville, L. I. This reclaimer is producing 50 gallons of clear lube oil on each refill cartridge at a cost of only $3.50. A good job . . . but, in less than two years, we have learned how to do it better.

Now we offer complete and continuous oil clarification. Above view shows a Model 4-P-8-90 Clarifier in service on a modern 950 hp. Diesel operating in tugboat service on the Card Towing Company's *Raymond Card*—maintaining refinery pure lubricating oil at a cost of only FOUR MILLS PER HUNDRED H.P. HOURS.

We are prepared to supply lube oil clarifiers to meet your requirements. Write for full details.

BRIGGS CLARIFIER COMPANY

3262 K STREET N. W. WASHINGTON, D. C.

Quincy COMPRESSORS

assure

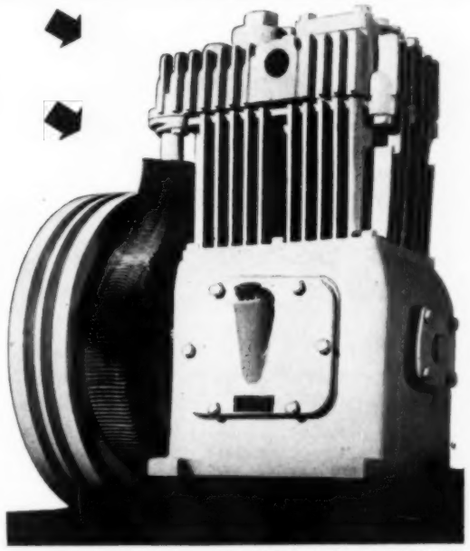
DEPENDABLE DIESEL STARTING

NEW Quincy Design Acclaimed *by the* DIESEL INDUSTRY

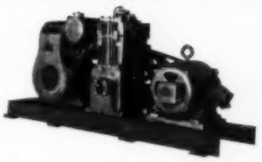
• New QUINCY COMPRESSORS are being furnished as standard equipment with Diesel engines made by several of the largest Diesel Engine manufacturers in the country. They have been installed in hundreds of the most modern up-to-date DIESEL Power Plants. The new QUINCY COMPRESSORS are also standard equipment on many well-known makes of Diesel Auxiliary Units for Marine service. Designed for every starting service requiring intermittent pressures up to 500 lbs. per sq. in. All types of mountings.

WRITE TODAY! for FREE New Catalog containing complete information on this new Quincy line for Diesel Starting.

Quincy Compressor Co.
430 Main St. Quincy, Illinois
Branch Offices:
New York Chicago San Francisco



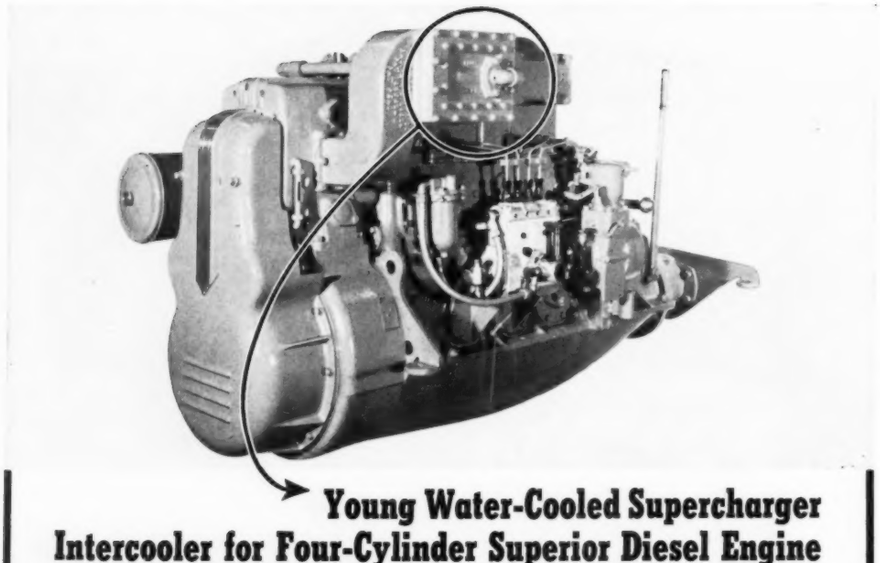
ABOVE: Model 320 Quincy compressor.



LEFT: Model D-320-S Quincy compressor mounted on extended base with both electric motor and gasoline engine. Changeable V-belt drive.

Only QUINCY OFFERS ALL THESE FEATURES

Timken Roller Bearings • Semi-Steel Pistons • Perfectly Balanced Crankshaft • Cushioned Steel Valves • Lynite Rods • Constant Level Oiling • Improved Cooling • Nickel Chrome Castings.



Young Water-Cooled Supercharger Intercooler for Four-Cylinder Superior Diesel Engine

Another Young cooling accomplishment. Superchargers greatly increase the performance of both Diesel and gasoline engines. Their use presents a problem of cooling the air from the supercharger in order to realize this increased performance. The above illustration represents the solution of one such problem by Young engineers. Place your particular problems before us.

Write for new descriptive catalogues

YOUNG RADIATOR COMPANY
Racine, Wisconsin

Young Quality

America's
DIESEL EQUIPMENT MARKET-PLACE

Dependable used Diesels, power machinery and equipment.
Four great distribution and service depots; coast to coast coverage.
We buy and sell. Send us your offerings. Advise us of your requirements. We can quickly locate the equipment you need.
Qualified engine experts and service men.
Courtesy to brokers and agents.
Address inquiries to Dept. DPR.

DIESEL POWER & MACHINERY CO.
• from coast to coast •
CHICAGO, 2012 Larrabee St.; MEMPHIS, 419 Monroe Street; NEW YORK, 31-30 Queens Blvd., Long Island City; LOS ANGELES, 2119 San Fernando Road.

JADSON

VALVES

Engineered for Diesels!

JADSON MOTOR PRODUCTS CO.
8354 WILCOX AVE. • BELL, CALIFORNIA

OUR 78TH YEAR
PICKERING GOVERNOR CO.
PORTLAND, CONN.

S·VIKING·
SAFETY CONTROLS *for* **DIESEL ENGINES**
VIKING INSTRUMENTS, INC.
STAMFORD, CONNECTICUT

DOUBLE SEAL
TRADE MARK REGISTERED
PISTON RINGS
Double Seal Ring Co. ★ Main Plant and Office FORT WORTH, TEX.
Branch Plant 137 Chambers Street New York City

• An outstanding Diesel installation deserves outstanding auxiliaries.
The Crosbyton, Texas, Power Plant Diesels are served by a Cooling Tower and Heat Exchangers manufactured by—
WATER COOLING EQUIPMENT CORP.
1137 Hereford St. Louis, Mo.

Latest Diesel Patents

A description of the outstanding patented inventions on Diesel and Diesel accessories as they are granted by the United States Patent Office. This information will be found a handy reference for inventors, engineers, designers and production men in establishing the dates of record, as well as describing the important Diesel inventions.

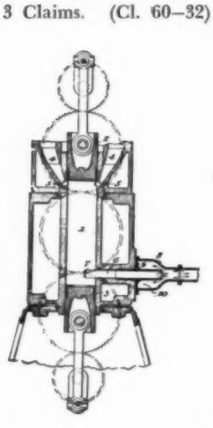
Conducted by C. CALVERT HINES*

2,168,528

EXHAUST PASSAGE OF TWO-STROKE INTERNAL COMBUSTION ENGINES

Michel Kadenacy, Paris, France

Application October 25, 1935, Serial No. 46,805
In Great Britain November 8, 1934
3 Claims. (Cl. 60—32)



1. A two-stroke cycle internal combustion engine, wherein the burnt gases are discharged from the cylinder into an exhaust conduit substantially as a mass whereby the said mass moves outward and thereafter returns towards the cylinder from a point which may be within the said exhaust conduit, the said conduit providing a free passage for the burnt gases to the limit of outward travel of said mass, and wherein an inlet is opened for the introduction of fresh charge while the exhaust port is still open and when the said issuance of the burnt gases is in full progress and causes a suction effect to be exerted in the cylinder, having means on the exhaust system for modifying the action of the said mass on the gases in the exhaust pipe, and the action of the return of the burnt gases upon the cylinder contents, the said means comprising a chamber other than the engine cylinder in open communication with the exhaust conduit at a point situated nearer the cylinder than the limit of outward travel of the burnt gases upon their mass exit from the cylinder, whereby upon the opening of the exhaust orifice for the discharge of the mass of burnt gases, the said mass is directed past the said communication during its outward motion, so that there is first an increase in pressure in the exhaust pipe adjacent the cylinder, which is transmitted through the gases contained in the exhaust pipe to the gases contained in said chamber, and thereafter a depression is formed in the cylinder and in the exhaust pipe adjacent the cylinder followed by a depression in the said chamber, and returning gases enter the said chamber, which is then at a lower pressure than the engine cylinder and the exhaust pipe adjacent the engine cylinder.

*Patent Attorney. 811 E. Street, N.W., Washington, D.C.

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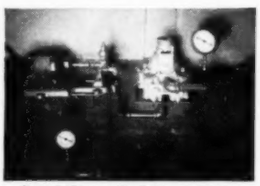

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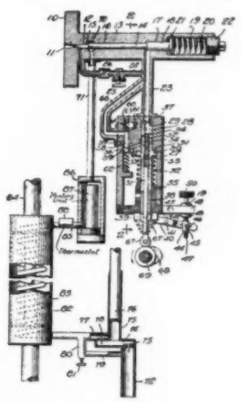
2,164,684

METHOD OF INJECTING FUEL INTO INTERNAL COMBUSTION ENGINES

Joseph G. Kimmel, Sarasota, Fla.

Application February 6, 1937, Serial No. 124,478

6 Claims. (Cl. 123 – 32)



6. The method of injecting fuel charges into an internal combustion engine cylinder through an injection nozzle, which comprises supplying a relatively heavy hydrocarbon fuel oil to the nozzle, and subjecting it to the injection action of a lighter hydrocarbon compound under temperature and pressure conditions approximating critical condtions, at least one of such conditions being above the critical point.

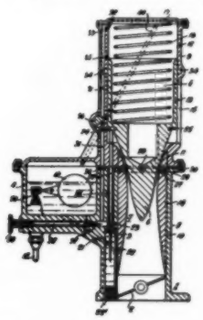
2,167,892

LIQUID FUEL FEEDING DEVICE FOR INTERNAL COMBUSTION ENGINES

Raymond Leslie Kent, Marston Green, near Birmingham, and Murray Duncan Scott, Bury Green, Cheshunt, England

Application November 3, 1936, Serial No. 109-038 In Great Britain November 8, 1935

3 Claims. (Cl. 261–50)



1. A fuel raising and carburetting device for use in internal combustion engines, comprising a fuel chamber, mixture passage including a Venturi tube, a pressure responsive member, means placing said member and the fuel chamber in communication with the throat of the venturi, a fuel jet including a jet opening and a needle valve for controlling the effective area thereof, means connecting the jet opening on one side thereof to the venturi and on the other side to the fuel chamber, and a choke piece movable into and out of the Venturi throat to vary the choke opening, both the needle valve and choke piece being actuated by the pressure responsive member which is so restrained that it will cause a depression in the system sufficient to raise fuel to the fuel chamber before it increases the jet and choke openings.

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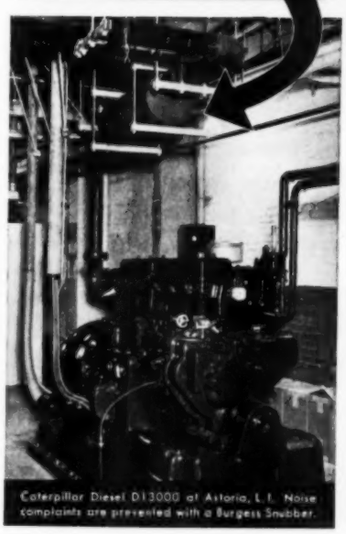

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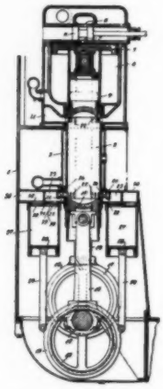
2,167,946

INTERNAL COMBUSTION ENGINE

Edward Gray, Detroit, Mich., assignor of one-half to Gar Wood, Detroit, Mich.

Original application May 15, 1933, Serial No. 671,177, now Patent No. 2,119,535, dated June 7, 1938. Divided and this application June 14, 1937, Serial No. 148,088.

7 Claims. (Cl. 123—50)



1. In combination, a cylinder, a pair of opposed pistons in said cylinder, a power shaft, means connecting said pistons with said power shaft for converting rectilinear movement of said pistons into rotary movement of said power shaft, said cylinder having intake and exhaust ports in the wall thereof adapted to be covered and uncovered by respective pistons, the intake ports being disposed whereby they are uncovered and remain uncovered by their respective piston for a longer period in a cycle of the engine than said exhaust ports, a manifold in communication with said intake ports, means for supplying air under pressure to said manifold, a supplemental valve between said intake ports and said manifold and adapted to prevent communication between the interior of said cylinder and said manifold until after the exhaust ports have been uncovered, said means for supplying air under pressure to said manifold comprising a pair of pumps mounted on diametrically opposite sides of said cylinder, and means connecting said pumps with the motion converting means of one of said pistons for actuation thereby.

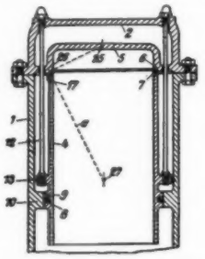
2,168,131

INTERNAL COMBUSTION ENGINE

Otto Mader, Dessau-Ziebigk, Germany, assignor to Junkers Flugzeug- und Motorenwerke Aktiengesellschaft, Dessau, Germany

Application July 22, 1937, Serial No. 155,013
In Germany August 3, 1936

7 Claims. (Cl. 123—173)



4. In an internal combustion engine having a liquid cooled cylinder, a cover, and a liner in said cylinder, said cover and liner having contact surface edges, at least one of said edges having a substantially spherical surface, the center point of which lies within said liner and on the axis thereof, means engaging said surfaces, and means for holding said surfaces in contact with said packing means.

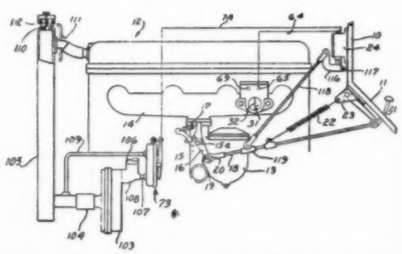
2,168,605

ATTACHMENT FOR INTERNAL COMBUSTION ENGINES

Lester H. Messinger, Jr., Trumbull, Conn., assignor to Messinger Devices, Incorporated, Bridgeport, Conn., a corporation of Connecticut.

Application November 27, 1937, Serial No. 176,844

21 Claims. (Cl. 123—103)



1. In combination with an internal combustion engine including a water cooling system, a pump operated in accordance with the speed of said engine and circulating the water in said system, a pressure responsive control means connected with the discharge side of said pump to be influenced by the pump generated and static pressures of the water in said system, other pressure responsive means connected elsewhere in said system to be influenced by the static pressure only of said system, and means whereby said second means balances out the effect of static pressure o nthe first means leaving the latter to be effected solely by changes in the pump generated pressure of the water in said system.

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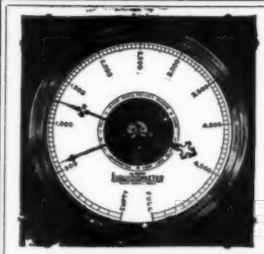

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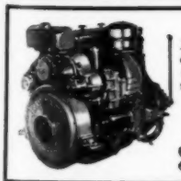

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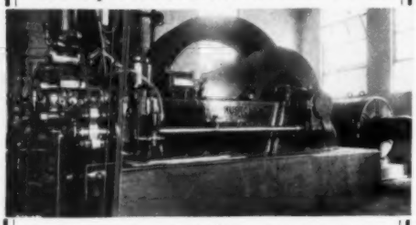

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PAUL H. WILKINSON, aviation editor of DIESEL PROGRESS and consultant on Diesel aviation, presented a comprehensive paper entitled, "The Performance of Modern Aircraft Diesels," at the 35th Annual Meeting of the Society of Automotive Engineers at Detroit on January 17. The paper was illustrated with slides showing some of the progress made with Diesel aircraft engines in Germany and France as well as in the United States.

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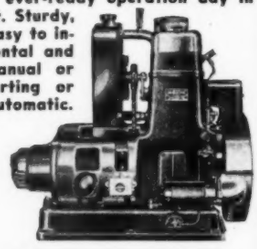

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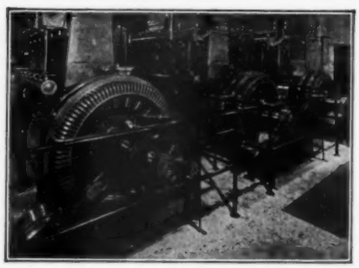

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